

(A)

TABLE A (Urban).

TABLE OF DEATHS during the year 1896, belonging to the Urban Districts of Surrey, classified according to Diseases, Ages, and Localities, and showing also the Populations of such Localities, and the Births therein during the Year.

URBAN DISTRICT.	POPULATION AT ALL AGES.		Registered Births.	MORTALITY FROM ALL CAUSES AT SUBJOINED AGES.							MORTALITY FROM SUBJOINED CAUSES, DISTINGUISHING DEATHS OF CHILDREN UNDER FIVE YEARS OF AGE.																							
	Census, 1891.	Estimated to middle of 1896.*		At all ages.	Under 1 year.	1 and under 5.	5 and under 15.	15 and under 25.	25 and under 65.	65 and upwards.	Smallpox.	Scarlatina.	Diphtheria.	Membranous Croup.	FEVERS.					Cholera.	Erysipelas.	Measles.	Whooping Cough.	Diarrhea and Dysentery.	Rheumatic Fever.	Ague.	Phthisis.	Bronchitis, Pneumonia and Pleurisy.	Heart Disease.	Injuries.	All other Diseases.	TOTAL		
															Typhus.	Enteric or Typhoid.	Continued.	Relapsing.	Puerperal.															
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	
Barnes	14,673	16,582	404	184	60	26	7	10	44	37	Under 5 5 upwds.	...	2 1	...	...	...	...	...	...	...	...	1	10	5	10	...	1	...	14	16	1	3	37	86
Richmond ...	26,875	29,230	665	374	99	38	15	13	116	93	Under 5 5 upwds.	...	4 ...	4 ...	1 1	...	...	...	...	...	...	...	10	9	9	...	...	...	1	31	1	6	61	137
Wimbledon...	25,761	30,984	875	365	100	46	15	9	114	81	Under 5 5 upwds.	1	1	2	...	...	3	...	...	2	...	1	1	15	12	...	...	...	19	14	...	2	92	146
Ham	1,479	1,514	33	18	6	2	...	1	4	5	Under 5 5 upwds.	...	...	...	...	...	...	...	...	...	...	1	...	2	1	...	...	...	...	1	...	2	1	8
Kingston ...	27,059	30,497	942	470	119	63	20	16	157	95	Under 5 5 upwds.	...	1	6	1	...	...	...	...	...	...	1	15	10	17	...	...	...	30	43	...	5	84	182
Esher and Dittons ...	7,966	8,758	208	101	15	8	2	4	41	31	Under 5 5 upwds.	...	...	...	...	...	...	...	...	...	...	...	3	2	1	...	1	...	13	2	1	1	13	23
The Maldens and Coombe	5,028	5,698	122	43	12	7	2	...	12	10	Under 5 5 upwds.	...	...	2	1	...	...	...	...	...	...	...	2	...	2	...	...	...	...	3	...	1	8	19
Surbiton	12,178	12,763	281	155	28	22	5	7	48	45	Under 5 5 upwds.	...	1	1	...	...	...	...	...	...	...	...	7	1	1	...	...	...	11	6	...	3	30	50
East & West Molesey ...	5,396	6,171	151	61	15	9	1	2	20	14	Under 5 5 upwds.	...	...	1	...	...	...	...	...	...	...	...	...	4	1	...	...	...	9	4	...	...	14	24
Chertsey	11,298	12,420	326	162	37	18	5	4	59	39	Under 5 5 upwds.	...	1	2	2	...	...	...	...	...	...	1	1	1	2	...	...	...	2	9	...	2	32	55
Weybridge ...	3,944	4,436	102	45	7	3	4	2	12	17	Under 5 5 upwds.	...	...	1	...	...	...	...	...	...	...	2	...	...	1	...	...	...	4	3	...	...	5	10
Walton ...	7,988	8,753	195	80	13	5	2	5	30	25	Under 5 5 upwds.	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	10	3	...	...	13	18
Farnham ...	5,545	5,915	152	78	14	9	2	5	26	22	Under 5 5 upwds.	...	...	...	...	...	...	...	...	...	...	1	7	1	2	...	...	...	4	2	1	1	8	23
Frimley	5,295	5,982	156	68	8	10	2	3	26	19	Under 5 5 upwds.	...	...	...	...	...	2	...	...	...	...	...	1	6	...	...	...	...	5	3	...	...	8	18
Godalming ...	8,117	8,893	211	102	21	14	7	3	34	23	Under 5 5 upwds.	...	1	4	...	...	...	...	...	...	...	...	...	...	...	...	...	1	10	1	...	19	35	
Guildford ...	14,316	15,944	366	227	50	26	12	13	79	47	Under 5 5 upwds.	1	...	...	...	...	...	...	...	...	...	1	15	3	3	...	...	...	28	19	...	1	35	76
Woking	9,776	9,092	342	130	35	8	11	5	34	37	Under 5 5 upwds.	...	...	...	...	...	1	...	...	...	...	1	2	4	...	...	...	...	11	4	...	1	32	43
Dorking ...	7,132	7,572	153	98	16	8	3	3	27	41	Under 5 5 upwds.	...	...	1	...	...	1	...	...	...	...	...	...	6	2	...	...	...	12	6	...	...	10	24
Leatherhead	4,305	4,721	81	49	12	2	3	1	16	15	Under 5 5 upwds.	...	1	1	...	...	...	...	...	...	...	...	2	...	2	...	...	...	3	2	...	2	6	14
Epsom* ...	8,417	9,227	191	104	21	3	3	5	33	39	Under 5 5 upwds.	...	...	1	...	...	...	...	...	...	...	1	...	4	...	1	...	...	11	5	...	...	16	24
Sutton† ...	13,977	14,118	324	146	35	20	7	7	38	39	Under 5 5 upwds.	...	...	1	...	...	...	...	...	...	...	...	10	2	6	...	...	...	2	10	...	1	24	55
Carshalton ...	5,425	5,745	174	76	20	5	2	4	25	20	Under 5 5 upwds.	...	...	1	...	...	1	...	...	...	...	...	1	...	3	...	...	...	8	3	...	...	18	25
Reigate	22,646	24,795	500	302	50	44	8	16	99	85	Under 5 5 upwds.	...	...	2	2	...	...	...	...	...	...	2	5	12	2	...	...	...	1	23	1	3	43	94
Totals ...	254,596	279,810	6,954	3,438	793	396	138	138	1094	879	Under 5 5 upwds.	2	9	25	7	...	17	1	...	7	...	5	99	85	77	...	...	...	11	222	6	34	609	1189

* In estimating the populations shown in Column 3 of Tables A, and used for calculating the rates in Tables B, the population of the County Lunatic Asylum in Woking Urban District has been distributed among all the Urban and Rural areas in the County.

For the purposes of this Table (excepting Column 2) and Table B, the South Metropolitan District Schools are excluded from Sutton.

(A)

TABLE A (Rural).

TABLE OF DEATHS during the year 1896, belonging to the Rural Districts of SURREY, classified according to Diseases, Ages, and Localities, and showing also the Populations of such Localities, and the Births therein during the Year.

RURAL DISTRICT.	POPULATION AT ALL AGES.		Registered Births.	MORTALITY FROM ALL CAUSES AT SUBJOINED AGES.							MORTALITY FROM SUBJOINED CAUSES, DISTINGUISHING DEATHS OF CHILDREN UNDER FIVE YEARS OF AGE.																								
	Census, 1891.	Estimated to middle of 1896.*		At all ages.	Under 1 year.	1 and under 5.	5 and under 15.	15 and under 25.	25 and under 65.	65 and up-wards.	Smallpox.	Scarlatina.	Diphtheria.	Membranous Group.	FEVERS.					Cholera.	Erysipelas.	Measles.	Whooping Cough.	Diarrhoea and Dysentery.	Rheumatic Fever.	Ague.	Phthisis.	Bronchitis, Pneumonia and Pleurisy.	Heart Disease.	Injuries.	All other Diseases.	TOTAL.			
															Typhus.	Enteric or Typhoid.	Continued.	Relapsing.	Puerperal.																
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.		
Chertsey	10,091	10,725	274	112	16	6	6	7	26	51	Under 5 5 upwds.	...	...	1	...	...	...	...	...	...	...	...	2	1	...	...	...	6	4	...	2	12	22
Egham.....	10,187	10,998	287	113	23	5	6	7	46	26	Under 5 5 upwds.	...	1	...	...	...	1	...	...	...	...	...	...	1	1	...	...	12	4	11	5	24	28
Farnham	13,411	14,523	438	189	43	21	11	10	55	49	Under 5 5 upwds.	...	1	5	1	...	1	...	...	...	...	1	2	3	...	...	...	8	15	18	12	34	64
Hambleton ...	18,428	19,665	525	237	47	18	6	7	63	96	Under 5 5 upwds.	...	...	1	1	...	3	...	...	...	...	...	6	13	1	...	...	15	12	31	3	26	65
Guildford ...	19,467	21,247	533	270	68	23	8	18	72	81	Under 5 5 upwds.	...	1	5	1	...	1	...	...	...	...	1	7	3	3	...	...	3	10	18	1	57	91
Dorking	10,091	10,620	231	121	16	11	8	1	44	41	Under 5 5 upwds.	...	...	1	1	...	...	...	...	...	...	5	2	1	...	...	...	7	2	...	...	15	27
Epsom†	18,000	16,873	382	195	38	16	11	10	60	60	Under 5 5 upwds.	...	...	2	2	...	...	...	...	...	...	4	3	1	...	...	1	14	10	20	5	33	54
Croydon† ...	28,717	29,981	765	386	105	55	18	21	106	81	Under 5 5 upwds.	...	...	3	1	...	5	...	...	...	...	17	13	17	...	...	3	30	...	4	72	160	
Reigate	13,934	15,146	368	167	37	14	9	5	50	52	Under 5 5 upwds.	...	...	1	...	...	1	...	...	1	...	1	2	10	5	...	...	9	15	22	1	29	51
Godstone† ...	18,913	17,605	425	221	45	13	5	12	68	78	Under 5 5 upwds.	...	1	...	1	...	1	...	...	...	...	2	1	3	3	...	...	2	18	...	...	27	58
Totals ...	161,239	167,383	4,228	2,011	438	182	88	98	590	615	Under 5 5 upwds.	...	2	18	6	...	13	...	...	1	...	3	41	42	36	...	...	10	117	2	14	329	620
												3	20	3	...	...	...	...	...	...	5	8	12	8	10	...	132	178	201	68	729	1391	

* In estimating the populations shown in Column 3 of Tables A, and used for calculating the rates in Tables B, the population of the County Lunatic Asylum in Woking Urban District has been distributed among all the Urban and Rural areas in the County.

† For the purposes of this Table (excepting Column 2) and of Table B, certain Public Institutions are excluded from the Districts in which they are situated :—Kensington and Chelsea District Workhouse Schools and Banstead Lunatic Asylum excluded from Epsom ; Cane Hill Lunatic Asylum and Holborn District Workhouse Schools excluded from Croydon ; Caterham Imbecile Asylum excluded from Godstone.



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TABLE OF CONTENTS.

	PAGES
The Local Government Board Tables. Introductory Remarks.	
I. County Sanitary Administration	4-12
II. County Death Rate Statistics and Summary of Notification Returns	12-17
III. Preventive Measures	17-18
IV. Isolation Hospitals and Disinfection	18-22
V. Drainage, &c.	22-28
VI. Sanitation of Dwellings	28-34
VII. River Conservancy	34-38
VIII. Local Government Board Inquiries	38-39
IX. Questions relating to Public Health	40-42
<hr/>	
X. An Account of Water Supplies in relation to Public Health from Reports of the Medical Officer to the Sanitary Committee of the Surrey County Council	42-88
Map of Geology of Surrey	50-51
Map of Water Supplies of Surrey	72-73

ANNUAL REPORT
OF THE
MEDICAL OFFICER OF HEALTH, FOR THE
ADMINISTRATIVE COUNTY OF SURREY.
1896.

The following Report relates to Public Health and Sanitary matters in the County of Surrey in 1896.

In accordance with the wishes of the Council, every effort Introduction has been made to collect the statistical returns, the district reports, and other materials necessary for the publication of an Annual County Report at as early a date as possible. This year the work has been facilitated by the greater promptitude with which the Medical Officers of Health throughout the County have made the reports and returns required by the regulations of the Local Government Board. The desirability of publishing the Tables A and B, the preparation of which occupies a great deal of time, has been carefully considered. These Tables summarize the corrected and adjusted statistical returns which the Local Government Board requires every Medical Officer of Health to make to

them, and copies of which, under the provisions of the Local Government Act, 1888, must be sent to County Councils. Although chiefly of value to experts, they are also of interest to some others, and may be required for reference at any time in the course of public Inquiries. The first Table (A) is published in full as in former County Reports. The second Table (B) is somewhat abridged, and for convenience, is placed in the body of the Report. These tables will be further referred to under the heading of "County Death-rate and Statistics."

It has been customary in County Reports to refer to what is being done or accomplished in various districts in the several departments of sanitary work. In order to facilitate reference to these departments or divisions, the Report is arranged in sections, indicated in the table of contents. The question of "Water Supply" has engaged most attention during the year under notice. The part of the Report relating to this important matter is detached from the remainder which it follows as a separate section. It gives a description of water supplies in the County, with remarks and observations chiefly derived from official experiences in sanitation and practical epidemiology, which extend over a period of about twenty-five years. This section of the Report is illustrated by maps.

I.—COUNTY SANITARY ADMINISTRATION.

County Medi-
cal Officer of
Health.

The above heading relates to various kinds of work carried on in the County. In this place it has been customary to summarize the work that devolves on the County Medical Officer. It has been previously mentioned that conferences, formal or informal, with representatives of the Council, colleagues and officials, constitute a necessary function of a County Medical Officer. During the first few weeks of the year 1896 these conferences related chiefly to the preparation of the District Annual Reports for the previous year, 1895.

The variety of subjects as to which consultative assistance is called for from the County Medical Officer is indicated by the following list taken from his diary.

WATER SUPPLIES.—Some of these conferences have, by desire of the Chairman of the Council, taken place at the County Hall, where questions relating either to the conservation of supplies, as in the case of the Aldershot Water Bill, or “agreements” with the London County Council, have been discussed. Other necessary interviews and communications have been held by the County Medical Officer with eminent authorities on the branches of Science, viz : Geology, Chemistry, Bacteriology and Epidemiology, all of which are intimately concerned in water questions. He has obtained a great deal of useful local information from Engineers, Managers, and Directors of Water Companies. He desires to thank those gentlemen collectively for their valuable help.

THE WORKING OF THE NOTIFICATION SYSTEM AND SANITARY ORGANIZATION generally forms a continuous subject for conference and discussion. It is one in which the County Medical Officer’s experience is always at the service of his colleagues. Public notice of these preventive measures is not courted, but on two or three occasions viz., an importation of Smallpox to Guildford, Diphtheria at Godalming, and the complaint about the continued prevalence of Typhoid at Farnham, such notice was inevitable. On the other hand, public attention was not arrested by a Typhoid outbreak at Kingston, the Smallpox at Wimbledon, or several other occurrences of a similar kind. Cases of Hydrophobia, and the prevalence of Diphtheria at schools in which the County Medical Officer has been specially referred to, should be mentioned here.

RIVER POLLUTION.—As to the condition of the **BLACKWATER**. This is a narrow watercourse forming the natural drainage channel of districts which are now very populous. The sewage disposal areas of

County Medical Officer of Health.

these districts, viz., at Aldershot, The Camp, and Farnborough form its borderland in the upper part of its course. There have been meetings as to the above, including one of the Joint Board of Surrey, Hants and Berks. It may here be mentioned that The Camp area, about which there was so much discussion in 1894-5, has wonderfully improved under Col. Jones. The condition of the river MOLE in connection with the drainage of the village towns of Leatherhead, Cobham and Ashted has received attention; so also has the WANDLE at Carshalton, and the WEX at Godalming, chiefly in connection with the provision for trade effluents from Tanneries and Paper Works.

HOUSES UNFIT FOR HABITATION.—This subject has engaged attention, especially in connection with the locality known as The Sandpits, Egham.

HOSPITAL QUESTIONS have received special attention in connection with Croydon Borough and Croydon Rural District, also at Godstone (site near Blechingley) Farnham (joint provision and site near Wrecclesham), Wimbledon (site at Merton).

The subjects of SMALLPOX and VACCINATION, SANITARY ORGANIZATION and ISOLATION have received special attention during the year.

The questions of burials in the Chalk formation at Banstead, Sewage and Refuse Disposal Schemes at Richmond, Barnes, Brookwood, Bletchingley, Guildford, Godalming, Nutfield, Carshalton, Womersley, Shalford, Milford, Oxted and Caterham, Sutton, Woking and Leatherhead, have been discussed with the County Medical Officer, at County and District Council Committees, and sometimes at meetings of experts. The subject of Sewer Ventilation at Esher, Godalming and Farnham has received attention.

At the request of the General Purposes Committee, the County Medical Officer conferred with Dr. Stevenson, the County Analyst, as to a list of drugs and medicines, samples of which may be obtained for purpose of Analysis.

The Local Government Board wishing for information respecting the provision for the necessary working expenses of the County Medical Officer's official post, he furnished them in writing with the fullest information in his power, and begs to record the fact that he did so.

The conditions under which he is in a position to give evidence at Trials or Public Inquiries have been referred to in previous reports of the County Medical Officer. There is also a minute of the Local Government Board on this subject.

Local Government Inquiries at which he has either given evidence, or made an impartial statement before the close of the discussion, are the following :—

Carshalton Sewerage Scheme.

Wimbledon Hospital.

Guildford Joint Hospital.

Local Government Inquiries of which notice was sent to the County Council, and which he attended for the purpose of gaining information, related to the refuse disposal and sanitation of Barnes, Caterham, and Oxted.

In connection with the above described, it has, of course, been necessary to make many inspections and visits to the localities immediately concerned.

In addition, the County Medical Officer has continued his observation of new and improved methods of sanitation, especially as applied to villages, and has watched with much interest the development of the systems by which the action of Bacteria may be effectively applied to the disposal or destruction of filth. He has also continued his observations on new practical methods of disinfection, and other matters pertaining to Hospital Hygiene.

The personal correspondence, official and confidential, entailed by these matters, and business of a kindred nature, has been greater in amount than in previous years.

Reports in
1896.

The Reports which the County Medical Officer has had the honour to make to the Sanitary Committee of the County Council during 1896 are as follow : —

1. The Annual Report for 1895.
- 2 On Water Supply.—interim Reports.
3. ,, Diphtheria and “school influence.”
4. ,, Isolation Hospitals.
5. ,, the organization of the Notification system.
6. ,, Local Government Board Inquiries.
7. ,, the progress of interception and drainage works for preventing the pollution by sewage or trade effluents of the following rivers and streams, tributaries of the Thames—viz., the Wey, the Tillingbourne, the Mole, the Wandle, the Blackwater, and the Pyl Brook—the last named being a narrow watercourse, which carries off the drainage of what is now a fair-sized town, viz., Sutton.
8. The Monthly Summaries.

SANITARY ORGANIZATION.

Sanitary
Organization. Following the precedent of the last two or three years, a few remarks may be offered on this subject.

The great diversity that exists in the character of the medical appointments for Sanitary Authorities has been sufficiently explained and dwelt upon in previous Reports. Good medical sanitary organization is a powerful factor in the safeguarding and improvement of the public health. This has been recognised to some extent, so far as the prevention of Cholera is concerned, by central organization. But the great value of good local medical sanitary organization in every town and large rural districts, in controlling Smallpox and other diseases, has still to be pressed on public attention. It is desirable,

therefore, to refer to the portions of previous Annual Reports of the County Medical Officer dealing with this part of the subject.

The whole question of sanitary organization is one that it is hoped will receive public attention in connection with the system of Local Government generally.

There remains only one aspect of the subject which has not yet been touched upon in these reports. Under the provisions of the Local Government Act, District Authorities are entitled to repayments of a moiety of the salary of the Medical Officer of Health from the County Fund. The amount thus paid for medical sanitary service in the County during 1896, is stated at page 168 of the volume of Reports presented to the Council on the 9th of February, 1897, and on page 231 of that presented to the Council on the 16th March, 1897. It will be seen by reference to these tables that only two districts in the County "do not claim." The Council is entitled to receive copies of the reports of the Medical Officers of Health, half of whose salaries are paid from the County Fund, but the Officers are under no further obligations so far as the County is concerned.

Under similar conditions half the salaries of the Inspectors of Nuisances is repaid from the County Fund. The amounts thus paid appear in the same tables of the volumes of Reports referred to above. These appointments are also quite independent of the Council, who can only very indirectly influence the character of the work performed.

This work may, under proper direction, be of a most useful character and greatly benefit the public health. The work should always be directed by the Medical Officer of Health. He has the responsibility of inquiring into the conditions which affect, or threaten to affect, health in his district. A practical Medical Officer of Health will generally draw up a scheme for himself with the object of systematically dealing with nuisances (that is, conditions which

are likely to injure health) in the order of their importance or urgency from a health point of view. The decision as to the measures to be taken for the removal or alteration of such injurious conditions rests ultimately, of course, with the Courts of Law, but obviously it depends mainly on the opinion of responsible Medical Officers. Consequently, no system of sanitary organization which leaves the Medical Officer out of account in such a matter as the dealing with nuisances—that is, standing conditions more or less dangerous to health—can possibly be otherwise than unsatisfactory. A long and varied official experience affords many proofs of this.

District Medical Officers of Health and Inspectors.

In two districts of the County, after a great deal of discussion, the principles now enunciated have been adopted in practice. In both these districts—viz., Croydon Rural and Surbiton—Inspectors of Nuisances have been appointed to act under the direction of the Medical Officers. In other districts some changes for the better have taken place in the system of nuisance inspection, abatement and removal. These changes have produced results which are readily appreciable by sanitarians. On the other hand, there are many Urban and Rural Districts in the County which stand much in need of improvements. In some of these cases the appointments of Inspectors are combined with those of Architects and Surveyors, a system which does not generally work well so far as the removal of nuisances is concerned. In some purely Rural Districts this combination of offices may not be without advantage, but in districts of urban character it is generally undesirable. The independent work of Inspectors of Nuisances is one of growing necessity. It includes the skilled examination of house drains, the inspection of food supplies, of cow-sheds, dairies, milk shops and slaughter houses, the service of notices and further proceedings. It is often incompatible with that of a Surveyor, and there are good reasons for its being continually guided by a Medical Officer of Health, who is qualified to act in this respect. It is hoped

that these observations will receive the attention of the District Councils, especially of the urban areas in the County, and that next year some further substantial advance in our sanitary organization may be recorded in the Annual Report for the whole County.

Appended is a list of the Districts showing the area, population, the names of the Medical Officers and the Inspectors of Nuisances :—

Rural District.	Approx. Area in Acres.	Population Mid., 1896.	Medical Officer of Health.	Inspector of Nuisances.	District Medical Officers of Health and In- spectors.
Chertsey	24,649	10,725	E. L. Jacob, M.R.C.S.	Mr. Durrant.	
Egham	7,786	10,998	W. T. G. Woodforde, M.D. ...	,, Menzies.	
Farnham	28,595	14,523	J. Lorimer, L.R.C.P.	,, Patrick.	
Hambleton	63,608	19,665	G. Hall, M.D.	,, Simmonds.	
Guildford	55,931	21,247	W. W. Lake, D.P.H.	,, Dewhurst.	
Dorking	39,200	10,620	E. L. Jacob, M.R.C.S.	,, Rapley.	
Epsom	31,188	16,873	,, , , , ,	,, Keal.	
Croydon	22,766	29,981	L. D. Mair, M.D.	,, White.	
Reigate	44,006	15,146	E. L. Jacob, M.R.C.S.	,, Walter.	
Godstone	53,189	17,605	C. E. Oldman, M.D.	,, Barralet.	

Urban District.	Area in Acres Approx.	Population Mid. 1896.	Medical Officer of Health.	Inspector of Nuisances.
Barnes	2,493	16,582	J. Adams, M.D.	Mr. Grylls.
Richmond	2,488	29,230	J. T. Rowland, M.D.	,, Parsons.
Wimbledon	3,200	30,984	E. Pocklington, M.R.C.S.	,, Mayne.
Ham	1,873	1,514	J. Donald, M.R.C.S.	,, Warner.
Kingston	1,187	30,497	H. B. Collins, D.P.H.	,, Pearce.
Esher & Dittons	5,978	8,758	A. Senior, M.B., D.P.H.	,, Henderson
Malden & Coombe	3,133	5,698	R. Davison, M.D.	,, Davidson.
Surbiton	3,035	12,763	Owen Coleman, M.D., D.P.H. ...	,, Nesfield.
Molesey	1,517	6,171	J. J. Knox, M.B.	,, Stevenson.
Chertsey ...	10,777	12,420	E. L. Jacob, M.R.C.S.	,, Smith.
Weybridge	1,371	4,436	,, , , , ,	,, Crawshaw.

Urban Districts	Area in Acres Approx.	Population Mid. 1896.	Medical Officer of Health.	Inspector of Nuisances.
Walton	6,859	8,753	E. L. Jacob, M.R.C.S.....	Mr. Hankin.
Farnham	768	5,915	S. G. Sloman, L.R.C.P.	„ Frost.
Frimley	7,674	5,982	T. Walcot, M.D.	„ Hodgson.
Godalming..... ..	807	8,893	W. Parsons, M.R.C.S.	„ Tribe.
Guildford	607	15,944	J. Morton, M.B.	„ Tribe.
Woking	8,889	9,092	W. W. Lake, D.P.H.	„ Wooldridge.
Dorking	1,473	7,572	E. L. Jacob, M.R.C.S.....	„ Matthews.
Leatherhead	3,508	4,721	„ „ „	„ Harding.
Epsom	4,400	9,227	„ „ „	„ Capon.
Sutton	1,900	14,118	„ „ „	„ Kain.
Carshalton..... ..	3,000	5,745	„ „ „	„ Wilson.
Reigate	6,000	24,795	„ „ „	„ Walter.

II.—COUNTY DEATH-RATE AND STATISTICS.

Statistics
for 1896.

The County Death-rate for 1896 was 12·2 per 1000 persons living. The average Death-rate of the County during the seven years, 1889-95, was 13·6. The Death-rate for the year under notice has therefore been below the average. The Death-rate of the Urban Districts was 12·3, and that of the Rural Districts 12·0.

The County Birth-rate for 1896 was 25·0 per 1000 persons living. The average Birth-rate of the County being 25·7.

The infant mortality (*i.e.*, the number of deaths per 1000 births) was 110 in the whole County. In the Urban Districts it was 114, and in the Rural 104.

By reference to Table B it will be seen that among the districts and towns with a fair-sized population, this rate varied remarkably. In the following, the rate was over 120, viz., Guildford Rural 128, Croydon Rural 137, Barnes 149, Richmond 149, Kingston 126, Guildford Town 137.

TABLE B (Rural), 1896. —Density, Birth-rate, Death-rates from all Causes, from the principal Zymotic Diseases, and from Diseases of the Respiratory Organs, and Infant Mortality.

RURAL DISTRICT.	Birth-rate to 1000 persons living.	DEATH-RATES TO 1000 PERSONS LIVING.				Deaths of Infants under one year to 1000 Births.				
		All Causes.	Principal Zymotic Diseases.	Phthisis.	Respiratory Diseases.					
Chertsey	10·4	0·56	0·56	0·56	1·68	58
Egham	10·3	0·45	0·45	1·09	0·45	80
Farnham	13·0	1·45	1·45	0·55	1·72	93
Hambledon	12·1	1·27	1·27	0·81	1·98	90
Guildford	12·7	1·36	1·36	1·13	1·36	128
Dorking	11·4	1·32	1·32	0·66	1·79	69
Epsom	11·6	1·01	1·01	0·89	1·84	99
Croydon	12·9	2·00	2·00	0·87	1·73	137
Reigate	11·0	1·45	1·45	0·59	2·64	101
Godstone	12·6	0·74	0·74	1·08	2·10	106
Total of above Districts	12·0	1·26	1·26	0·85	1·76	104

TABLE B (Urban), 1896. —Density, Birth-rate, Death-rates from all Causes, from the principal Zymotic Diseases, and from Diseases of the Respiratory Organs, and Infant Mortality.

URBAN DISTRICT.	Birth-rate to 1000 persons living.	DEATH-RATES TO 1000 PERSONS LIVING.				Deaths of Infants under one year to 1000 Births.
		All Causes.	Principal Zymotic Diseases.	Phthisis.	Respiratory Diseases.	
Barnes	24·4	11·1	1·69	0·90	1·75	149
Richmond	22·8	12·8	1·57	1·09	2·53	149
Wimbledon	28·2	11·8	1·48	0·61	1·36	114
Ham ...	22·3	11·9	2·64	...	3·30	182
Kingston	30·9	15·4	2·13	0·98	2·82	126
Esher and Dittons	23·7	11·5	0·69	1·48	1·03	72
The Maldens & Coombe	21·4	7·5	1·40	...	1·23	98
Surbiton	22·0	12·1	1·10	0·86	1·02	100
East & West Molesey	24·5	9·9	0·97	1·46	1·30	99
Chertsey	26·2	13·0	1·13	1·37	1·61	113
Weybridge	23·0	10·1	0·45	0·90	2·03	69
Walton	22·3	9·1	0·23	1·14	1·71	67
Farnham	25·7	13·2	2·03	0·68	1·01	92
Frimley	26·1	11·4	1·50	0·84	1·17	51
Godalming	23·7	11·5	1·01	0·90	2·81	100
Guildford	23·0	14·2	1·69	1·76	2·45	137
Woking	37·6	14·3	0·88	1·21	1·32	102
Dorking	20·2	12·9	1·32	1·58	2·11	105
Leatherhead	17·2	10·4	1·27	0·64	1·69	148
Epsom	20·7	11·3	0·54	1·52	1·73	110
Sutton	22·9	10·3	1·42	0·35	1·42	108
Carshalton	30·3	13·2	1·04	1·39	1·22	115
Reigate	20·2	12·2	1·09	1·13	1·77	100
Total of above Districts	24·9	12·3	1·36	1·02	1·85	114



In a County which is chiefly residential, and in which there are few industries in which women are specially employed away from home, an infant Death-rate of 120 must be considered rather high. A rate that notably exceeds this is certainly worthy the attention of Local Authorities, especially where, as at Guildford, the rate has been increasing of late years. It is very much in the interest of health resorts (where the Death-rate is quoted as an index of their sanitary condition) that inquiry should be made as to the causes which determine the rate of mortality among infants with a view to remedy. Parental ignorance or neglect often conduces to a high infant Death-rate, and in this way the effect of local sanitary improvements in water supply, drainage, &c., which tend to lower the general Death-rate, may become obscured.

The Death-rate at ages 1-15 was 5·7 per 1000 ; that between ages 15-65 was 7·1 ; and that at ages of 65 and upwards was 66. These rates, as might be expected, are below those of the English Life table.

The Zymotic Death-rate for the whole County was 1·32 per 1000, or, otherwise expressed, 132 per 100,000.

The causes that chiefly contributed to this Death-rate were : Measles (36 per 100,000) ; Whooping Cough (33 per 100,000) ; Diarrhœa (29 per 100,000) ; and Diphtheria (18 per 100,000). By reference to Table A, it will be seen that in the Croydon Rural District there were 5 deaths from Typhoid, a preventible disease, also 5 from Diphtheria, 1 from Erysipelas, 18 from Measles, 13 from Whooping Cough, and 18 from Diarrhœa. At Kingston there was also a comparatively heavy Typhoid Death-rate, as well as a death from Puerperal Fever and Erysipelas. There were also 15 deaths from Diphtheria and Membranous Croup, 16 from Measles, 11 from Whooping Cough, and 18 from Diarrhœa. At Farnham there was a death from Puerperal Fever and Erysipelas, as well as 9 deaths from Measles.

Phthisis.

The Phthisis (Consumption) Death-rate, which in some parts of England and Wales averages nearly 200 per 100,000 population, is happily low in our County, and apparently tends to become lower. From the valuable Tables by Dr. Tatham, page lxxxi., of the recently issued Report of the Registrar General, it appears that during the ten years 1885-94 the Surrey Phthisis Death-rate was decidedly below the average in the South-Eastern Counties. In 1895 the rates for the South-Eastern Counties were as follows :—

Surrey	121	per	100,000	population.
Kent	123	„	„	„
Sussex	134	„	„	„
Hampshire	147	„	„	„

In the year 1896 the rate (after corrections for institutions) was as low as 96 per 100,000 in Surrey.

There are some Districts which seem to be particularly favoured in respect of their comparative immunity from Phthisis. It has been noticed that for several years the Death-rate at Sutton has been remarkably low. On the other hand the town of Guildford has had a rather high Death-rate from this cause. The drainage operations in the last-named town will probably produce a good effect on the prevalence of this Disease.

In connection with the prevalence of Phthisis and Tuberculous Diseases generally, the supervision of cowsheds is of the greatest importance.

The Death-rate from respiratory Diseases was 182 per 100,000 in 1896.

SUMMARY of NOTIFICATION RETURNS for the whole year 1896, showing the relative prevalence of Diphtheria, Scarlet Fever, and Typhoid (Enteric) Fever in the several Sanitary Districts in the County. The first column under each heading represents the actual number of cases recorded in each district; and the second column, the proportion these cases bear to every 1000 persons living in the district.

DIPHTHERIA.

Esher and Dittons.....	1	·1	Wimbledon Urban	29	1·1 Diphtheria.
Epsom Urban	2	·2	Dorking Rural	14	1·3
Egham Rural	3	·2	Croydon Rural	43	1·4
Frimley Urban	2	·3	Chertsey Rural	14	1·4
Epsom Rural	8	·4	Weybridge Urban	6	1·5
Woking Urban	4	·4	Croydon Borough	173	1·5
Sutton Urban	7	·5	Kingston Urban.....	49	1·8
Hambledon Rural.....	11	·5	Malden and Coombe.....	11	1·9
East Molesey	3	·5	Ham Urban	3	2·0
Surbiton	8	·6	Barnes Urban.....	30	2·0
Richmond	17	·6	Chertsey Urban.....	24	2·1
Walton Urban	6	·7	Carshalton Urban	12	2·2
Guildford Urban	10	·7	Dorking Urban	16	2·2
Reigate Urban	18	·7	Leatherhead Urban	11	2·5
Reigate Rural.....	12	·8	Godalming Urban	24	2·8
Godstone Rural	18	·9	Farnham Urban	17	3·0
Guildford Rural.....	23	1·1	Farnham Rural	47	3·5

SCARLET FEVER.

Dorking, Rural	1	·1	Croydon Borough	281	2·5 Scarlet Fever.
Carshalton, Urban.....	4	·7	Godalming, Urban.....	21	2·5
Guildford „	10	·7	Farnham „	14	2·5
Epsom „	8	·9	East and West Molesey...	14	2·5
Guildford Rural	24	1·2	Sutton Urban.....	41	2·9
Chertsey „	12	1·2	Weybridge „	12	3·0
Hambledon „	25	1·3	Epsom Rural	59	3·2
Dorking Urban	11	1·5	Godstone „	63	3·3
Farnham Rural	23	1·7	Woking Urban	33	3·3
Egham „	19	1·8	Richmond „	93	3·4

Kingston Urban	50	1·8	Chertsey „	42	3·7
Reigate Rural	29	2·0	Barnes „	62	4·2
Croydon „	62	2·1	Leatherhead „	19	4·4
Walton Urban	18	2·2	Wimbledon „	122	4·7
Esher and Dittons	20	2·2	Malden and Coombe	28	4·9
Surbiton	28	2·3	Reigate Urban	147	6·4
Frimley Urban	13	2·4	Ham „	15	10·1

ENTERIC AND CONTINUED FEVER.

Typhoid (Enteric and Continued Fevers).	Dorking Rural	0	·0	Esher and Dittons	3	·3
	Walton Urban	0	·0	Wimbledon Urban	10	·3
	Malden and Coombe ...	0	·0	Croydon Rural	14	·4
	Reigate Urban	4	·1	Godalming Urban	4	·4
	Epsom „	1	·1	Chertsey Rural	4	·4
	„ Rural	3	·1	Reigate „	7	·5
	Guildford „	2	·1	Weybridge Urban	2	·5
	Dorking Urban	2	·2	Kingston „	14	·5
	Farnham Rural	3	·2	Richmond „	17	·6
	Egham „	3	·2	Leatherhead „	3	·6
	Chertsey Urban	3	·2	Ham „	1	·6
	Godstone Rural	7	·3	Barnes „	10	·6
	Carshalton Urban	2	·3	Frimley „	4	·7
	Sutton „	5	·3	Woking „	8	·8
	Guildford „	5	·3	Hambleton Rural	16	·8
	East and West Molesey	2	·3	Croydon Borough	119	1·0
	Surbiton	4	·3	Farnham Urban	13	2·3

PUERPERAL FEVER.

Puerperal
Fever.

25 Cases of Puerperal Fever occurred in the Administrative County during the year, and 4 in Croydon Borough.

The cases occurred as follows :—In the Surbiton, East Molesey, Chertsey, Farnham, Frimley, and Godalming Urban Districts, and in the Hambleton, Guildford and Godstone Rural Districts, 1 case each ; in the Kingston Urban and Egham Rural Districts, 2 cases each ; in the Richmond Urban District, 3 cases ; and in the Wimbledon Urban District, 5 cases.

SMALLPOX.

There were 5 cases in the Administrative County and 1 in Croydon Smallpox. Borough.

They were distributed as follows :—In the East Molesey, Guildford and Dorking Urban Districts, 1 case each ; and in the Godstone Rural District, 2 cases.

MEASLES, INFLUENZA, AND WHOOPING COUGH.

The Notification Act does not at present extend to these diseases, Measles, consequently the information is not sufficiently reliable to admit of their Influenza and prevalence being recorded as above. Whooping Cough.

III.—PREVENTIVE MEASURES.

The Vaccination Commission, after a most exhaustive Inquiry, Preventive extending over seven years, issued their final Report in the year 1896. Measures. The finding of the Commission is entirely in favour of Vaccination, as a necessary measure of State Medicine.* Compulsory Vaccination constitutes the main defence against Epidemic Smallpox. It is, in the Commissioners' words, impossible to contemplate its abandonment at the present day "without dismay." But that it requires to be supplemented by other measures is evident. The Commissioners do not fully describe these measures. The subject is, however, being sufficiently discussed elsewhere by experts and those who have practically to deal with epidemics. Opinions are divided. Some think that systematic (*i.e.*, compulsory) re-vaccination should be super-added to compulsory primary Vaccination ; while others are of opinion that in the development of medical sanitary organization (a term which connotes a great deal Sanitary of the work usually described in these Reports) there is an Organization. additional means of prevention which has been proved to be feasible and effectual.

* In the Calendar of the London University "State Medicine" is defined as "Medicine in its relations to Health and Disease in the Community, and to the influence of material and social conditions on the production, prevention, and control of Disease in the Community."

School
Supervision.

The nature of the preventive work in Surrey, is described in the Reports of the Medical Officers for the thirty-three districts in the County. The fullest description is given in the Reports for the Croydon Rural, Guildford Rural, and Woking Districts. These Reports deserve special notice for the reason that the Medical Officers have spared no effort to extend preventive influences by a system of school supervision which has been conducted with assiduity and tact, and, as it seems with the prospect of marked success.* It only remains to add to this section that on all matters connected with the notification and prevention of Epidemic Diseases the County Medical Officer is in constant communication with his colleagues, and that his assistance in difficulties is always freely given.

IV.—ISOLATION HOSPITALS AND DISINFECTION.

Isolation,
Disinfection,
Vaccination,
&c.

Progress has been made in the provision of Isolation and Disinfection arrangements during the year under notice.

Thus the Joint Board for the Guildford District has resolved to make addition to their present accommodation at the fork of the railways near Guildford, by erecting extra sleeping rooms for nurses, bath rooms, discharge rooms, &c.

It has also, in spite of much difficulty, taken steps to provide separate accommodation for initial cases of Small Pox on a site at Whitemoor Common.

At Bletchingley (Godstone District) the able Medical Officer of Health brought the question forcibly to the front in connection with an outbreak of Scarlet Fever. A site has been obtained, and a temporary Hospital is now being erected.

* The remarks on this point of the Medical Officer of Health for the Guildford Rural District, which includes Pirbright, are very suggestive. At the same time the known tendency to epidemic fluctuation of Diphtheria prevents conclusions being drawn prematurely respecting the efficiency of any preventive or controlling measure.

At Surbiton the Medical Officer reports that, after lengthy Isolation, &c. negotiations between possible constituent Districts, it has been arranged that the hospital at Tolworth will in the future serve for Surbiton, Esher and the Dittons, Ham, Coombe and the Maldens. He reports on the desirability of establishing telephonic communication between the Hospital, the Council Offices, and a Public Call Office. He also represents the necessity for replacing the old-fashioned appliances for disinfection by more trustworthy methods and arrangements.

In the month of May, the Croydon Corporation Hospital was opened with ceremony. It is exceedingly well situated and well equipped.

Croydon Rural District Council made provision for Infectious cases in July for the first time. This was by arrangement with the Croydon Corporation for admission of cases into their hospital at Waddon, pending the erection of a proposed hospital at Beddington Corner.

Progress has since been made towards the provision of a Hospital for which the site at Beddington Corner was obtained. The plans show accommodation for twenty-eight patients. The Council has also purchased an ambulance.

The Croydon Corporation is trying to secure the co-operation of the various authorities in north-east Surrey to provide a Smallpox Hospital for an extensive area and a large population. In the opinion of the County Medical Officer this is a prudent policy, and when he has been referred to by authorities such as at Wimbledon, he has advised them strongly to fall in with a large and comprehensive scheme. As regards the site to be selected for such a Hospital, he is of course unable to express any opinion until the arrangements are matured.

The Hospital should be, like that at Cuddington or Whitemoor, in a thoroughly well isolated situation.

Isolation, &c. The practice of removal of Smallpox cases from the County Districts of Surrey to a Hospital in London has always been discountenanced by the County Medical Officer (*vide* Annual Reports, 1893, &c.)

A site has been obtained for a joint hospital for Farnham Urban and Rural Districts, and under Geo. Fred. Roumieu, Esq., J.P., of Willey Park, who takes a strong personal interest in the matter, considerable progress has already been made in the preparation of the hospital itself.

The Frimley Council is meeting with difficulty, raised by the Commissioners of Woods and Forests, and is not as yet in a position to record substantial progress.

At Wimbledon a site has been obtained which is certainly not ideal, but which is said to be the only one obtainable. It is the Upper Cemetery Field. Plans have been prepared for the erection of a hospital which will be a decided improvement on "Durnford Lodge," which has hitherto done duty for isolation accommodation, admittedly of a most unsatisfactory character.

At Barnes further progress is being made by extra provision for Convalescents. The Medical Officer of Health writes:—"I believe that the ground selected for the erection of the Convalescent Wards is in every particular the best that could have been found, and is very conveniently situated with respect to the existing building. The necessity for it, independent of the advisability of separating the convalescents from the acute cases, has been proved during the past year, although we have not had so large a number to treat as in the two preceding years. It happened that we had a case of Typhoid, several cases of Diphtheria, and ten cases of Scarlet Fever at the same time. One ward was taken up by the Typhoid, one by the Diphtheria, and the ten cases of Scarlet Fever in the other two wards, just double the number they were built for. I hope the

building will be pressed forward, for it is impossible to know how Isolation, &c. soon we may require it."

At Richmond strenuous exertions are being made by the Mayor and the Joint Hospital Committee for the erection and establishment of the Isolation Hospital which they have so long striven to obtain.

The Joint Hospital for Chertsey, Weybridge and Walton, situate at Ottershaw, is recorded as doing excellent service.

The Joint Hospital Board for Epsom Rural, Leatherhead, Sutton and Carshalton has nearly completed its Hospital on Cuddington Downs. The sewage of the Hospital will be precipitated chemically, and then treated by filtration over a specially prepared plot of land, without under drainage, of half an acre in extent and four feet deep.

At Reigate the Corporation has purchased two acres of land adjoining the Rural District Council's Isolation Hospital at White Bushes, in the parish of Horley, and plans are in course of preparation for a Ward Block, an Isolation Block, an Administrative Block, and other buildings. It is to be hoped that this is a step towards union with the Rural Districts.

The Dorking Rural District is no longer content to be without accommodation of this kind. It has already moved for an Inquiry under the Isolation Hospitals Act with the object of being combined with the Dorking Urban District.

It will thus be seen that the year has been one of marked progress, and that County influence is producing very good results in the direction of increased provision for the isolation of cases of infectious disease.

The further action taken for the prevention of the spread of Infectious Diseases is thus described in several of the Reports :—

"Disinfectants were supplied, and their proper use explained; nuisances, when found on the premises, were abated as far as was

Disinfection. practicable; the well water, when suspected, was analysed; and after the recovery, death, or removal of the sick, the final cleansing and disinfecting of the houses and articles was secured, the first stage of the disinfection. viz., that by sulphur-fumigation, having been performed at most of the cottages by the Sanitary Inspector. Infected articles were removed from most of the houses, together with the patients, and from many other houses after the illnesses were over, and were disinfected by the Washington Lyons' Disinfectant at the Isolation Hospital, and compensation was given when any infected articles were destroyed."

In the case of small-pox outbreaks re-vaccination was urged and facilities were provided for its performance.

Early
Diagnosis.

With regard to diagnosis, and the aid thereto furnished by laboratory tests, which are applicable now to Diphtheria and Typhoid Fever, the Reports of the Medical Officers of Health show that Sanitary Authorities are seeing their importance, and defraying the comparatively small expense which they entail. There are now abundant facilities for such research or testing at several laboratories within easy reach.

The Medical Officer for Surbiton gives some very instructive examples of the great advantages of the EARLY resort to the bacteriological test in dubious cases of sore throat.

V.—DRAINAGE, SEWERAGE, SEWAGE DISPOSAL, SCAVENGING, &c.

Under these heads account is taken of further progress which has been made in the County in 1896, in a direction which is essential to the preservation of Health.

Drainage,
Shere.

A Scheme for the drainage of Shere has been submitted to the Local Government Board and approved. The Scheme provides for sewerage Upper Street, Gomshall Road as far as the Schools, Church Square, Sandy Lane, Lower Street and Middle Street.

The whole of the sewage will gravitate to a receiving well on land adjoining Lower Street, and from there it will be raised by means of pumps worked continuously with power supplied by a water-wheel up to a plot of land at a distance from the stream and at a higher level where it will be treated.

At Guildford the work of connecting houses with the new system of drainage has been in active progress. Up to December 31st the number reported as completed was 2045---viz., on the high level sewers 865, and the low level sewers 1180. The total number of inhabited houses in the Borough is 3065. The outfall works are at a distance from the town, but the same attention is needed for the prevention of nuisance as if they were close at hand. Drainage,
Guildford.

Woking continues to be in the van as an Authority which is endeavouring to cope with the sewage difficulty by systematic scavenging provision. This includes the bi-weekly cleansing of the pail closets, the fortnightly collection of house refuse, and the removal of cesspool contents under proper precautions. Drainage,
Woking.

It has been frequently urged in these Reports, that in the less thickly populated parts of the County where drainage schemes are difficult, they may be avoided by attention to those details; so that any district which succeeds in carrying out systematic scavenging in a satisfactory manner is worthy of all praise.

Nevertheless, with its rapidly growing population and its large proportion of villa residences, a sewerage system has long been wanted for the Woking District. The Scheme which has been finally approved, and which will probably be commenced soon, involved the purchase by Provisional Order of 42 acres of land at Woking Park Farm.

The Albury Scavenging System continues to work very well.

At Blechingley (Godstone District) Drainage Works have been completed, and connections with houses within 100-ft. of the sewers have been effected.

Scavenging,
Albury.

Progressive
Pollution of
the Chalk
Formation.

As regards Caterham, Kenley, and other areas on the chalk formation, which are becoming more and more populous, the sewage difficulty is as yet far from being satisfactorily solved. The practice of draining into wasting cesspools in the chalk formation from which water supplies are derived, is very dangerous. Indeed, under some circumstances, it may become more dangerous than the pollution of rivers and streams, which has engaged so much attention of late years.

At Oxted the scavenging of the district, which deserves the most serious attention of the Sanitary Authority, is under the consideration of the Local Government Board.

In the Croydon Rural District Report the improvement of the Merton Sewage Works, in accordance with a scheme described in a previous Report, is being proceeded with. The ventilation of the sewers has been improved.

In some of the rural parts of this district (Saundersstead and Coulsdon) the houses drain straight into the chalk formation.

This is the case also at the Metropolitan Police Station, Kenley, which was visited by the County Medical Officer along with the Medical Officer of Health for the district last August. This and other like cases should be proceeded against by the District Authority under the nuisance clauses of the Public Health Act.

Farnham,
House
Drainage.

At Farnham the improvement of house drainage is at present receiving attention with a view to proceedings.

In the Farnham Rural District, which includes Hale, Heath End, Bourne, &c., there is obviously a great deal to be done in the direction of sanitary improvement generally.

Drainage,
Frimley.

At Frimley it has been decided to relay all the drains in the Sewage Farm (proper) at a lower level, and to make a filter bed of coke breeze through which the effluents may pass before entering the Blackwater River. The works are now in progress. At Frimley

Street the provision for the drainage of the little population on to a so called "Sewage Farm" has been much discussed.

At Godalming the drainage works have been in operation nearly a year. There remain, however, a considerable number of premises in the High Street and at Farncombe which have not yet been connected with the system. Drainage,
Godalming.

In the Hambledon District there has been a very great deal of discussion on the question of sewage disposal, but no definite steps have been taken. Cranleigh is the one place that is prominent for its efforts to deal successfully with this most difficult problem "village sanitation." At Witley there was some talk of a filtration scheme, but the cost, which must be considered trifling compared with the really large expenditure incurred by other Authorities in the County, seemed nevertheless enough to deter the Authority. Drainage,
Cranleigh.

The work of constructing the sewers and outfall works at Cheam is now complete; the work in Cuddington Parish will be finished soon, and then the connection of the house drains with the sewers will be proceeded with. The reconstruction of Worcester Park drainage will at length be accomplished. Drainage,
Worcester
Park.

At Ewell an Inquiry has been held as to a sewerage scheme which involves the taking of land for sewage disposal otherwise than by agreement.

At Cobham a sewerage scheme is contemplated for the purpose of preventing a certain amount of pollution of the River Mole. Drainage
Schemes.

At Ashted a scheme for sewerage or sewage disposal is under consideration.

At Leatherhead a scheme for sewerage and sewage disposal, which involves the taking of land, otherwise than by the agreement with the owner, is now under the consideration of the Local Government Board.

- Sutton
Bacterial
Treatment of
Sewage.** At Sutton experimental operations have been going on which are certain to be instructive. The Bacterial method of sewage treatment is here referred to. This method is still in the trial stage, and it would be premature to report on it at present.
- Carshalton
Drainage
Scheme.** At Carshalton a scheme has been passed for the sewerage of the district, and for the treatment of the sewage upon an area of land in Wrythe Green Lane, which the owner was willing to sell for that purpose.
- During the year the drains of all the houses in Harold Road, which had not been connected already, were diverted to the sewer in that road, which discharges at present into the Sutton system of sewers.
- Sewer
Ventilation.** At Esher, the Dittons, Richmond, Farnham, and Godalming great attention has been paid to the prevention of nuisance from sewer ventilators.
- Drainage,
Molesey.** At Molesey the new sewerage system is in operation, and the work of house connection is being rapidly proceeded with, greatly to the benefit of the district.
- Drainage,
Weybridge.** Weybridge is possessed of one of the best sewage outfall systems in the County. The connections with the sewerage system are going on steadily. During the year the drains of 326 houses were connected with the sewers, making a total of 762 connections since the commencement of the work in 1895. At all these houses the closets have been converted (where necessary) into water closets, to which water is laid on from separate cisterns for flushing purposes, and the trapping, ventilation and disconnection of the drains and waste pipes have been secured; and drains have been tested in every case.
- Drainage,
Hersham.** In January, the Local Government Board held an Inquiry at Walton into the petition of the District Council for power to acquire land at North Weylands Farm, in their district, for the purpose of treating the sewage of Hersham, and of part of Walton, by means

of chemical precipitation and land irrigation. The scheme was Drainage Schemes. opposed by the neighbouring District Councils of Esher and Molesey, and by the owners of Esher Place and Ember Court, but the Board issued their Provisional Order in favour of the petition. When the Bill confirming the Order came before a Select Committee of the House of Commons in July, the same opponents of the scheme petitioned against it, but the Committee decided in favour of the Council. The opposition then petitioned the House of Lords against the Bill, but it was too late in the Session for it to be heard by the Committee of that House. Afterwards negotiations took place between the Council and the opponents of the scheme, and matters are now arranged.

The Scavenging of Merrow has not got beyond the stage of being Scavenging. discussed.

The Drainage of Stoughton has yet to be accomplished. Application has been made for a loan to carry out the work, but the Local Government Board does not appear to be satisfied with the proposed special drainage area.

The Ripley Sewers have been somewhat improved.

It will be gathered from the above account that the year has on the whole been marked by active and substantial progress. The County Medical Officer regrets that he is as yet unable to report that advance has been made in reduction of the cost of sewerage schemes. A sense of public duty compels him to say that, having regard to other much needed improvements in sanitary organization, the cost of some of the schemes seems large.* He hopes, however, that the progress of Engineering and Biological Science may enable him to report otherwise next year.

In this part of the Report it must also be noted that besides the Absence of Drainage.

* In one village of Surrey it will be remembered that the Works of Sewerage involve a half-crown rate, and that in another village the estimated cost of a scheme was certainly not less than £70,000 !

districts already mentioned on the Chalk area there are others, such as Chertsey and Egham, where the absence of sewerage or adequate system of scavenging permits of the progressive pollution of the soil in such a way as to cause much anxiety to the Medical Officers of the Districts and County.

Effective
Systems.

In this short Report it is not possible to give an account of the Sewage Farms such as Epsom, or the Sewage Processes such as those of Wimbledon and Richmond, which work quite satisfactorily year after year.

VI.—SANITATION OF DWELLINGS.

Sanitation of
Dwellings.

Under this heading it is convenient to refer to what has taken place during the year in the direction of maintaining or improving the sanitary condition of dwellings, on which the health and comfort of the population largely depend. Work of this class embraces (1) a comprehensive survey of a district in which the water supply, drainage, and other sanitary conditions are taken note of in the case of every dwelling house; (2) the operation of Bye-laws for the prevention of nuisances injurious to health, and for regulating the construction of houses; (3) the removal or abatement of nuisances injurious to health in the precincts or vicinity of dwellings under the powers of the Public Health Act; (4) the prevention of overcrowding; (5) the reconstruction or improvement of dwellings under the powers of the Housing of the Working Classes Act, 1890; (6) the sanitary improvement of villa residences, by skilled inspection and advice freely given.

Croydon
Rural.

In the Croydon Rural District, which comprises Wallington, Mitcham, Merton, Morden, and Beddington, the work of the Health Department includes:

(1) A complete survey of the district by proper assistants (inspectors.)

(2). Amended Bye-laws relating to nuisances new streets and buildings, and the drainage of old buildings.

[The necessity of such Bye-laws is conspicuously shown by such a case as the drainage of the Metropolitan Police Station into the Chalk formation at Kenley. In this district 80 to 100 new labourers' cottages are to be shortly built, and it is hoped the Bye-laws will be in operation before they are erected.] Croydon Rural.

(3). The removal or abatement of nuisances injurious to health by routine sanitary inspection as described fully in the Report of the Medical Officer of Health. [The sum total of visits made under his directions for the above purpose amounts to 4724. It would be impossible to over-estimate the value of this work.]

(4). The necessity of providing against overcrowding by means of a comprehensive scheme is under consideration.

(5). During the year, 48 houses have been represented by the Medical Officer of Health as so dangerous to health as to be unfit for habitation. The Table of Results is given at page 40 of his Annual Report. In a small proportion the houses have been closed or demolished, while in the majority the condition and surroundings were so transformed after the Magistrate's order to close, that the dwellings were practically rendered fit for habitation.

(6). Inspections are made of villa residences, but the results are not recorded separately, as is done at Surbiton.

At Surbiton it is recorded by the Medical Officer of Health that a thoroughly well qualified and active Sanitary Inspector has been appointed to act under his directions. During nine months of 1896 it appears that some 70 residences, some of them of the villa class, had their sanitation changed for the better, and that 124 houses of another class, probably let at weekly rents, had sanitary conveniences supplied, which they were previously without.

At Kingston action has been taken under the Housing of the Working Classes Act in a few cases, but the improvements effected thereby appear, from the Medical Officer's Report, not to have been

so thorough as they might be. Reference is also made in the Annual Report for the Borough to the inadequacy of the Sanitary Staff. In connection with the occurrence of Typhoid in this district, the Medical Officer of Health reports that in three cases "impure water was the means of infection."

New Malden. At New Malden a great many small but valuable sanitary improvements of houses were effected.

Wimbledon. At Wimbledon the Medical Officer of Health states that the houses 1-23, Berkeley Road, which were in a dangerous state, have been closed, and that a demolition order is to be applied for. The drains of 160 houses have been entirely reconstructed and laid to stand the water test, with man-holes for inspection purposes, &c. The Report of the Sanitary Inspector is incorporated with that of the Medical Officer of Health.

Barnes. At Barnes great improvements are being made in the system of dust removal which obviously concerns the health and comfort of all classes of the population.

Richmond. At Richmond a "List of places where special inspections have been made" is given.

Molesey. At Molesey material improvements in sanitation of dwellings have been effected in 703 houses which have been connected with the new sewerage system.

Esher. At Esher and The Dittons the Medical Officer of Health reports that a house-to-house inspection has been made of the cottage property, a register of defects has been kept, and the owners put under notice to do the necessary work.

United Districts. The United Districts (comprising the following, viz., Chertsey Urban and Rural, Weybridge and Walton, Epsom Urban and Rural, Carshalton, Sutton and Leatherhead, Reigate Urban and Rural, Dorking Urban and Rural) are all administered by one Medical Officer of Health. The population of these districts is 145,000,

and the area comprised is no less than 178,000 acres. Needless to say that with such an area and population sanitary administration on the system of Croydon Rural would be an utter impossibility. In the last-named district the population is 30,000, and the acreage about 23,000. It is necessary to bear this in mind in recording the work of improving house sanitation which requires systematic procedure and the continuous control or direction of some one who might be said to adequately represent the Sanitary Authority, in this essential part of their functions. It may, of course, be taken for granted that the administration of the districts by the able and experienced Medical Officer is in this respect as in others as good as it can possibly be under the circumstances, but it is well to remember what those circumstances are.

Systematic house-to-house inspection is referred to in the reports for the united Districts, but the County Medical Officer gathers that these are made on special occasions, as they have been by himself in other districts in the County.

At Frimley, the Royal Albert Orphanage has been inspected, and Frimley. the Medical Officer of Health reports that in no case is the area per bed in the dormitories less than 25 to 30 superficial feet, or the air space less than 300 feet. He adds that the Health of the Inmates has been good. But this is not equivalent to saying that the sanitary conditions are satisfactory for an establishment of such a kind. The arrangements for the isolation of sore throats or other infectious ailments are also insufficient.

At Farnham, houses have been condemned as unfit for habitation at Hart's Yard and Cemetery Cottages.

As regards the prevailing sanitary conditions of the picturesque town, and the need for improvements in house sanitation, the following passages from the Report of the Medical Officer of Health speak for themselves :—

“I find that in 11 out of 19 cases which I investigated on the Farnham. occurrence of disease notified to me, no water was laid on to the

Farnham. premises, and orders were consequently given that it should be supplied for flushing purposes.

On Wednesday, 20th May, Dr. Seaton came to inspect the Waterworks, and made many inquiries as regards the water supply of our district; he considers our case rate from Typhoid higher than it ought to be, and thinks it might be reduced by putting more pressure on owners of houses to take the town supply, and strongly urges me to take measures to this end.

Accordingly, on 3rd June, I commenced a house-to-house visitation (which I continued on the 18th, 19th, and 23rd June, and 27th July) in Bridge Square, Red Lion Lane, Weydon Hill and Weydon Mill, Abbey Street, and part of Waverley Estate, with a view to ascertaining in what proportion these houses were supplied with water to a sufficient extent. I determined that the test of sufficient supply should be whether their closets were furnished with a laid-on supply for flushing or not. In the above-mentioned district I visited 147 premises, and found that in only about 41 was the water supply sufficient according to this test. I consequently recommended that the owners of the remaining 106 should be called upon to supply this deficiency, on the ground that a closet without water is a nuisance, whether it should by chance happen to be dirty at the time of inspection or not; and the Council wrote requesting owners to give a proper supply. On the 20th October Dr. Seaton lent me a draft report to the Sanitary Committee of the Surrey County Council, showing Farnham Urban District at the bottom of the statistical table of the prevalence of Typhoid Fever for the whole County, and inferring that it was due to a large number of polluted shallow surface wells which are in use for drinking purposes in parts of the town. The Council considered this Report, and the Sanitary Committee subsequently decided to recommend that the whole of the owners of the properties on which I had reported in July and August be written to, and that the Surveyor be instructed to watch the premises, and when he found a nuisance existing to proceed against the owner. I believe that about a quarter of the 106 had already been taken in hand before this resolution was passed. On 17th December Dr. Seaton came, at my suggestion, and went round nearly the whole town, seeing houses with regard to their water supply. From his knowledge of the circumstances which in his long experience as a Medical Officer of Health, so often conduce to the development of "Fever" in the poor quarters of towns, he was impressed with the need for enforcing the laying on of water to the closets, without which it is practically impossible to keep them clean, and to prevent the spread of "Fever."—*Farnham Urban District Report.*

At Hale and Heath End, near Aldershot, a virulent outbreak of ^{Hale.} Diphtheria has compelled the attention, not only of the District Authority but of the population themselves, to the dangerously insanitary condition of their houses, which frequently stand on ground saturated with filth of all kinds. The Medical Officer of Health intends to report progress shortly. At Bourne, there are many houses in a most insanitary condition for want of adequate water supply.

At Godalming, very material improvements have been made in a ^{Godalming.} very large proportion of the houses in the town. The opportunity of improving the sanitation of every house about to be connected with the new system of drainage has been taken full advantage of, with the result that in a short time many of the insanitary house conditions, which are to be found in all old towns, will have been replaced by those which are healthy. This will obviously be greatly to the benefit of the town. The Borough Surveyor of Godalming informs the County Medical Officer that there still remain a certain number of houses not yet connected with the sewerage system.

At Guildford similar kind of work has been in progress. The ^{Guildford.} Medical Officer of Health reports that the work of the Sanitary Inspector in examining the connections to the new sewers, and in seeing that the old cesspools were emptied and filled up, has been very arduous, and he has been most efficient and industrious.

In the Guildford Rural and in the Woking Districts, it is understood that the Medical Officer of Health is engaged in organizing a survey, which will probably in the course of another year be complete, and which will afford information as to the source of water supply, and the mode of drainage of every house in this part of Surrey. There can be no doubt that such information will be exceedingly valuable, not only to the authorities immediately concerned, but also to the County Council.

The Medical Officer of Health also reports on the endeavours of the District Council to meet complaints "as to the conduct of the Gypsies," by which insanitary conditions arise.

Godstone.

In the Godstone District, as shown by the Reports of the Medical Officer of Health and the Surveyor, active steps have been taken to improve the cottages by removal of nuisances at Bletchingley, Caterham, Godstone, Limpsfield, Oxted, Lingfield, Tandridge, Titsey, and Warlingham. Altogether, there were 213 cases of unhealthy conditions removed or abated. In addition, the powers of the Housing of the Working Classes Act were brought into operation at Crowhurst in one case, at Tillingdown in four cases, at Tatsfield in one case. The houses were thus made fit for habitation.

Egham.

At Egham, the condition of the houses occupied by the poorest classes continues to give grave anxiety. The Medical Officer of Health has condemned more houses in the Sandpits. But on the other hand the scheme for providing houses to accommodate displaced persons progresses very slowly.

VII. RIVER CONSERVANCY.

The questions that have arisen in the County relating to the above have been dealt with partly under the head of Drainage.

In addition there have been a great number of cases of river pollution which have required the consideration of the County Medical Officer. Some of these it is difficult to regard as very serious from a public health point of view.

Thames
Floods.

The subjects of greatest importance which have been before the Council are—firstly, those of the Thames floods, which seriously affect the Public health, and—secondly, the prevention of river pollution by liquid trade refuse which is detrimental to residential localities.

The first-named subject—viz., the question of Thames Floods, was reported on at considerable length by a Committee specially

appointed by the Conservators. This Report appears as an Appendix to that of the Sanitary Committee, which was before the Council in February (*vide* Vol. I., pp. 75-93).

In connection with this subject reference may be made to some valuable remarks in the Report of the Medical Officer of Health for Kingston.

The difficulties connected with the subject of trade refuse disposal as shown by the history of the Schemes, propounded for the drainage of Carshalton, are not yet surmounted. The account of the subject having been set out fully, by letters, in the printed Reports of the Council, it is only necessary here to give short extracts, so that the principal points in the discussion may be made clear.

Trade Refuse
Disposal.

CARSHALTON.

It will be remembered that at the beginning of 1896, the position was that the District Council of Carshalton hesitated to carry out their original Mitcham Gravitation Scheme (A) on account of the unprecedented cost which it threatened to entail, and which must fall entirely on the village.

Carshalton
Drainage
Schemes.

“As explained to you in my letter of the 28th March, 1895, the Council have endeavoured to arrange for the joint utilization of the site which they are empowered to acquire at Mitcham, with the Croydon Rural District Council, but after taking the question seriously into their consideration, the Croydon Council have come to the conclusion that they are not able to entertain the proposal.”—(*Extract of letter of the District Council to the Local Government Board, forwarded to the County Council*).

* * * * *

Some indications are then given of the reasons of the great cost of the Scheme A.

“There are two owners of the land in question, both of whom are opposed in the strongest possible manner to the acquisition of the site for the purpose in view, and my Council are well aware that any attempts by them to treat with such owners privately must be futile, and accordingly they have only the alternative course of ascertaining the cost of such land by

arbitration, and from the information they now have, they find that the cost of this would be abnormally heavy, partly because of the strenuous opposition of the owners and partly on account of the peculiar circumstances having reference to this land.

“Accordingly, before my Council proceed to arbitration, they have felt it to be highly essential to face seriously the question of whether or not the scheme at present before your Board should be further proceeded with.

“The population of Carshalton is between 5,000 and 6,000, and the assessable value for District Council purposes is £27,332.

“The actual amount of Mr. Baldwin Latham’s estimate is £49,043; included in this sum is £13,265 for land purchase, cost of wayleaves and easement for effluent drain.”

The Council are quite satisfied that this sum is far less than the actual cost will be, and that on a moderate computation the scheme cannot cost less than £70,000, and may cost considerably more.

Altogether, the Council conclude that the scheme is far too costly for their district, and they are satisfied that a scheme completely efficient and in every respect suitable can be carried through at a much less cost.—
(*Extract of letter of the District Council to the Local Government Board forwarded by them to the County Council.*)

On these grounds the District Council asked to propound another scheme.

It will be seen, therefore, from the above that the District Council contemplated a second, apparently less costly, scheme, B instead of A, the Mitcham gravitation scheme.

The Local Government Board decided to reopen the whole question and appointed an Inquiry as to B, but in the meanwhile it appeared that the scheme B left out the liquid trade refuse. Thereupon the persons interested applied to the County Council to express their view, Mr. Frost, a manufacturer, writing to the County Council as follows :—

The Carshalton District Council are applying for a loan for Carshalton sewers, and I find, after great trouble, that the mill owners on the Drainage Schemes. River Wandle get no relief whatever.

It will be within your recollection that a system was passed for a gravitation scheme for Carshalton which would have given us the relief we wanted, but, a new Board being elected, immediately set to work on a different system, and the result is a pumping scheme which is utterly useless to all the low-lying part of Carshalton, and which does not afford the manufacturers, who are now compelled to drain direct into the River Wandle, any opportunity of disposing of their sewage other than as now.

* * * * *

The Inspector having appointed April 7th for his Inquiry, I trust that, even at this short notice, your Council will be represented.

The Sanitary Committee instructed the County Medical Officer to attend and represent their views, which were identical with those represented by him at the Godalming Inquiries in 1891-2. But he was not authorised to go further and to offer an opinion as to the comparative merits of the two schemes, A and B, and the Government Inspector did not invite him to do so. The case rested therefore on the statement that Scheme B did not satisfy the County Council. After the Inquiry, the Local Government Board gave their Official sanction to the scheme, and though the County Council protested by letters, the answer of the Board was from their standpoint unsatisfactory as will be gathered from the following extract of their letter :—

“The observations of the Surrey County Council have been considered, but the Board are not prepared upon such grounds as are suggested to take upon themselves the responsibility of refusing sanction to a loan for a scheme which, as they are advised, is in itself satisfactory.”

They have accordingly issued their formal sanction to loans amounting to £34,000. (*Extract from letter of the Local Government Board to the County Council.*)

County
Council
Minute.

Finally, the County Council placed on record their view of the matter.

It was resolved that "a communication be sent in reply to the foregoing, expressing the regret of the Council at the decision arrived at by the Local Government Board in this matter, also pointing out that considerable trouble is anticipated in consequence thereof from the hindrance which the Council fear will thus be caused to efforts being made by them towards securing the cessation of river pollution throughout the County."—(*Extract from Minutes of the Sanitary Committee of the Surrey County Council, dated July 7th, 1896.*)

* * * * *

GODALMING.

Godalming
Drainage.

In contrast to the above it is satisfactory to record that at Godalming the efforts to prevent pollution by liquid trade refuse have already been attended with good results, and the scheme there is in a fair way to prove ultimately successful.

VIII.—LOCAL GOVERNMENT BOARD INQUIRIES.

Local
Government
Board
Inquiries.

In connection with the subjects referred to in this Report on Public Health, viz., works of water supply, provision of hospitals, drainage, sewerage, scavenging, &c., frequent applications are made to the Local Government Board by District Councils, for loans of money to enable them to carry out the works. These loans are granted only after inquiry on the spot by a representative or representatives of the Board. The date and place of the Inquiry is usually decided on by the Board a few days before it is held, and the District Council is informed. The Inquiry sometimes relates to matters of considerable importance from a public health point of view. It is, moreover, conducted in a most impartial spirit, and is thoroughly exhaustive. It is obviously desirable, in the interests of the County as a whole, that the Council should receive early official information of such Inquiries, and should then have opportunity of being represented. The reasons for this might be supposed to be sufficiently apparent. They are (1) That at the Inquiries

opportunities not otherwise obtainable are sometimes afforded of ^{Local Govern-} gaining information from the evidence given, as well as from inspec- ^{ment Board} tions and examinations. These opportunities are appreciated by a Council which concerns itself in all matters relating to public health. (2) That the representatives of the Board may have full information, which in some instances can alone be afforded by the representative of the Council. (3) That the views of the Council on matters that concern them should on occasion be represented.

It is, perhaps, significant of the attitude of the Local Government Board to County Councils, that the reasonable request of the Council, made some years ago, to be placed on the list of those to whom the Board would send notice of intended Inquiries, has only just been in part acceded to. This concession has been made after joint representation, renewed by County Councils, as shown in the following letter from the Secretary of the Board to the Secretary of the County Councils Association :—

SIR,—I am directed by the Local Government Board to advert to your letter, forwarding a copy of a resolution passed at a meeting of the Executive Council of the County Councils Association, with reference to Local Inquiries held under the direction of the Board, with respect to schemes of sewerage and sewage disposal.

The Board will direct that notice of any such Inquiry shall be given to the County Council of the County within which the District of the Local Authority, by whom the scheme is proposed, is situated.

They direct me to add, however, that it must be understood that the notices of inquiries are forwarded for the information of the County Council, and are not to be regarded as an invitation to the County Council to be represented at the Inquiry. It must also be understood that a notice will not be sent to a County Council in the case of a scheme proposed by the Council of a County Borough.

I am, Sir, &c.,

A. D. ADRIAN.

Assistant Secretary.

IX.—QUESTIONS RELATING TO PUBLIC HEALTH.

Questions
relating to
Public
Health.

Under this head it will be convenient to summarize matters not otherwise mentioned in this Report. They are all discussed elsewhere, either in the Reports of the Sanitary Committee, the County Medical Officer, or in those which have been published by the District Councils. The Annual Reports of the Medical Officers of Health are now issued in such a form as to be available for public use, and they are frequently referred to in the newspapers which circulate in the districts. It is only necessary, therefore, that they should be briefly recorded in this place, so that the history of the year should be complete.

The Report for the Croydon District contains an account of the working of the Notification Act as applied to Measles.

In the same Report under the headings of Water Supply, Sewerage, and Cemeteries, questions of sanitation, partly practical and partly (as it seems to many) theoretical, are discussed.

As this subject forms part of the separate section on water supply, it is only necessary here to briefly state the conclusions arrived at by the County Medical Officer.

(1). In seeking fresh water supplies, from where the cretaceous formation is on the surface, sources should be secured as remote from the population as practicable. Clandon Downs, Leith Hill, Hindhead, the Forked Pond, are typical examples of desirable sources.

(2). Sewage should not be permitted to be passed into soak-away cesspools in the water-bearing chalk or sand, where, as is generally the case, the population must derive their water supply from the locality. Any such cases as that of the Metropolitan Police Station at Kenley might be dealt with successfully under the Sections of the Public Health Act, 1875, relating to nuisances injurious (*i.e.*, dangerous) to health.

(3). The provision of sewerage systems for the prevention of underground pollution in water-bearing strata is as necessary as for the prevention of river pollution. Questions relating to Public Health.

(4). In laying out new institutions to be situate on the chalk, sand, or other porous formation, it is desirable to pay special attention to the disposal of sewage, &c., as has been done at the Cuddington Hospital.

(5). The danger from cemeteries to water supplies, in the way that has been suggested by the Sutton District Council, is problematical.

(6). The promotion of inquiry and research by chemical and bacteriological analyses, as well as by a study of the movements of underground water in water-bearing strata, is essential in order to acquire better knowledge of the facts connected with this problem.

The subject of Regulated Trades hardly receives the amount of attention to which it is entitled at the present day. There are comparatively few so-called "offensive businesses" in Surrey. The part of sanitary work which chiefly concerns the public health is that which relates to the skilled inspection and control of cowsheds, dairies, milk shops, slaughter houses, and butchers' shops. The rapid advances in the science of Bacteriology and Pathology during the fifteen years since Koch of Berlin discovered the Tubercle Bacillus, have brought us within measurable distance of a time when practical application of this knowledge should make a very great difference in the prevalence of tuberculous diseases, (including consumption of the lungs and some of the wasting diseases of children), among both men and animals. Such application must, however, be preceded by a diffusion of the knowledge which is at present confined to experts, and by illustrations of the ways in which infection with tubercle by means of food can be proved to have taken place. These and other points connected with practical administration, may for the present be reserved for special

Questions
relating to
Public
Health.

report. In the meanwhile, it may be noted that sanitary organization in this direction has yet to be created and developed. At present a record is made in the reports for most of the thirty-three districts of the number of premises registered and visited, upon a stereotyped plan which dates from about twenty years ago.

The new regulations relating to sanitary conditions at factories and workshops necessitate more inspectorial work by or under the direction of the Medical Officer of Health of the district. This subject is adverted to by the Medical Officer of Health for Kingston.

The inspection of schools and school children for the improvement and protection of health, is receiving special attention in some districts, notably Kingston (*vide* the Report of the Medical Officer of Health on the sight of school children), in Guildford Rural and Woking (*vide* the Report of the Medical Officer of Health on Diphtheria precautions), and in the Croydon Rural District.

X.—AN ACCOUNT OF WATER SUPPLIES IN RELATION
TO THE PUBLIC HEALTH FROM REPORTS OF THE
MEDICAL OFFICER TO THE SANITARY COMMITTEE
OF THE SURREY COUNTY COUNCIL.

The following is taken from Reports to the Sanitary Committee made during 1896 by the County Medical Officer, and is now arranged and presented in compact form :—

In the Reports I have had the honour to make during the past six years, the subject of Water Supply has been regarded chiefly from the point of view of river water supply and the need for protection against pollution, which, with the growth of population in the suburban and rural parts of Surrey, tended to increase. The attention given to the River Wey and its tributaries, and the influence of the Council in promoting schemes of sewerage, such as those for Weybridge, Guildford and Godalming, have produced their effects in improving the character of the water supply of the vast population who derive their water from the River Thames. The support given by the Council to the acquisition of additional powers by the Thames Conservancy Board has still further tended to diminish sources of pollution which at one time threatened to overwhelm the self-purifying powers of the streams and rivers flowing to the Thames. Except in the case where “nuisance to the locality” may be said to be caused by the discharge of factory or trade refuse into a stream, the prevention of river pollution is, in this part of the country, mainly necessitated by considerations of water supply in relation to the Public Health. Much remains to be done to encourage and promote thoroughly efficient sewerage for aggregations of populations on the river sides such as will prove a benefit to the locality, besides affording additional safety to the continued use of rivers as sources of drinking water supplies. But, having regard to the subject of water supplies and their relation to the Public Health generally, it will be recognized that there are other aspects of it which urgently need to be brought under the notice of

the Committee I think it may be said that no part of this subject deserves attention more than the supply of water from the cretaceous formation. It has been more and more resorted to as a source of water supply of late years. Its quantity as well as its character is coming to be a subject of interest to the general public. Its natural purity, and the fact that the hardness of that which is derived from the chalk formation can be easily reduced, constitute its advantages. On the other hand the possible risks of its contamination have been dwelt on by the Medical Officer of the Local Government Board and other high authorities. The subject has been under your notice in certain exceptional aspects of late, and the necessity of watching and inquiry has been clearly stated by the Chairman of the Council.

The following Report is intended as a review of our knowledge of this subject. It is accompanied by such details of the area, distribution, quantity and quality of the water supplies from the cretaceous formation in this County as I have been able to gather :—

INSPECTION OF SURREY WATER SUPPLIES.

Inspection
of Water
Supplies.

For the purpose of this Report I have now visited all the works for public Water Supply in Surrey. To some of these I have paid several visits, in order to acquire information. Generally speaking, I have been favourably received by the officials of the Companies. I have always explained to them that my object is to obtain as full information as possible for the County Council respecting water supplies and their influence on Public Health.

The headings under which I have sought and obtained information more or less complete are the following :—

1. The nature of the source (Geology, &c.).
2. The situation of the source.
3. The description of works.
 - (a) Pumping Stations.
 - (b) Reservoirs.
 - (c) Mains.
 - (d) Domestic fittings.

4. The area of supply of the Company.

(a) Potential.

(b) Actual.

Inspection
of Water
Supplies.

5. The map of the Chief Trunk Mains.

6. The total volume of water derived from the source per day, per week, or per year, and the variations (if any) in the same.

7. The population supplied. The number and character of the same.

8. The amount or volume of water supplied per head of the population.

9. The sufficiency or otherwise of such amounts.

10. The analyses, original or periodical.

At various times and according to opportunity I have visited the Works and conferred with the officials of the following Companies and Authorities:—

RIVER THAMES SUPPLIES.

Southwark and Vauxhall Company.

Lambeth „

West Surrey „

South West Suburban „

CHALK SUPPLIES.

Sutton Company.

Leatherhead „

Epsom District Council.

East Surrey Company (Kenley and Caterham).

Woking Company (Clandon).

Guildford Corporation.

Aldershot Company.

Richmond Corporation (in part).

And other smaller sources.

LOWER GREENSAND SUPPLIES.

The Upland Sources (Forked and Hammer Ponds). The yield of these is estimated at about 3,000,000 gallons daily. If arrangement could be arrived at with the existing owners this supply might be available.

Farnham Company.

Godalming „

Inspection
of Water
Supplies.

Dorking Company.

Reigate, now belonging to the East Surrey Company.

And other smaller sources.

BAGSHOT SAND SUPPLIES.

Frimley and Farnborough Company.

I have also, on my own responsibility, visited other sources of supply away from Surrey. [This I have done for the purpose of comparison and in order to inform myself specially on points that may arise for discussion, as to which the Committee would desire to have all the information obtainable. In this way I have visited the works of the Chelsea and other Thames River Water Companies, the works at Brighton and South Coast Watering Places, and in the Isle of Wight, where the water is derived from the chalk formation.

SOURCES OF WATER SUPPLY.

Sources
of Water
Supply.

The rain water from which all supplies derive their source is in some parts of the country districts intercepted for domestic purposes. An apparatus known as Roberts' Rain Water Separator may be used.

“ It rejects the dirty and stores the clean water. It is made of zinc, upon an iron frame, and the centre part or canter is balanced upon a pivot. It is self-acting, and directs into a waste pipe the first portion of the rainfall, which washes off and brings down from the roofs soot and other impurities. After rain has fallen a certain time the separator cants and turns the pure water into the storage tank.”

It has been suggested that in purely country districts rain water in large quantities might be collected in the following way. Writing in the “ Field ” on the 18th June, 1887, the well-known authority Mr. Bailey Denton says :—

“ One inch of rain falling on the surface of an acre is equivalent to 22,622 gallons; and supposing that half an acre of land be set apart and rendered impervious for the collection of rain falling on it during the six winter months, the amount collected where the rainfall is least, as in the East of England, during that period would be about 170,000 gallons (assuming the winter rainfall to be 15 inches) or

enough to satisfy the wants of nearly 100 persons for a period of three months (an exceptionally long drought) at 20 gallons a head daily, an ample quantity for all individual and household purposes. Tanks can be built at a cost varying from £3 to £5 per 1,000 gallons, and on the chalk formation, where scarcity is soonest felt, at even less cost. In most cases a collecting area can be selected free from contamination. The area upon which the water would be collected need merely have a concrete floor with cement surface, railed off to prevent stock running over it, and the storage tank may be constructed underneath.

The sources of water supply are classified as follows:—

Upland Surface Water consists of the rain which falls upon hard rocks, as in the Lake Districts. *Moorland Water* is that which falls on, and is collected from the high moors, as in parts of Yorkshire. Both these above-named waters are remarkably soft and pure at their source, the organic matter in Moorland water being of vegetable origin. *Surface Water from Cultivated Ground*, is rain water which carries with it a certain amount of organic impurity into the rivers. *Sub-Soil Water* is that which percolates through the surface of the soil into a pervious sub-soil. If distant from any aggregation of houses, it may be pure, but if under villages and towns, it is almost always impure. *Subterranean or Deep Well-Water*.—This is the water which travels through the sub-soil to a depth so that it can only be reached by boring. The term “artesian” is applied exclusively to wells in which an impervious stratum is pierced to get access to a spongy water-bearing stratum, in which the water lies imprisoned beneath under pressure, ready to rise by natural forces. *Springs* are the sources of supply where an impervious stratum comes to the surface and throws out (a) a sub-soil water from pervious stratum above, constituting a land spring; or (b) where a subterranean water is thrown to the surface in any way, constituting an ascending or deep spring. *River Water*.—All these various sources of supply, being mingled together, constitute the water of rivers.

Sources of
Water supply.

It may be desirable to add a word on the subject of sub-soil and ground water. It has been said that the action of the soil in regard to water is in reality of a threefold nature:—

- (1) It may transmit water as in the case of exceedingly permeable, coarse gravels.
- (2) It may imbibe the moisture. Clay exhibits this property of imbibing water in a high degree, but on the other hand, it is very slightly permeable.
- (3) Water may be held by rock, or a more porous, permeable formation, at a certain rest level, in the same manner as water is held by a sponge immersed in water, which flows from it when the sponge is lifted out. This has been described as a saturation of a rock, and in the case of the rocky water-bearing strata such as the New Red Sandstone or the Chalk, it constitutes what is generally known as the ground water. The coarser the grain of any rock, the more freely will water travel through it, and the springs which it feeds will be more quickly affected by rainfall. The great water-bearing strata in which the water is derived from this rest level or plain of saturation, are the Chalk, the Oolites, and the New Red Sandstone.

My own experience as a Medical Officer of Health relates mainly to the New Red Sandstone and the Chalk, which are analogous in this respect, namely, that the deep subterranean reservoirs, from which the water is frequently drawn, are fed by water mostly passing through fissures, sometimes of considerable size.

The Chalk formation is one of the most absorbent, and a large proportion—something like 30 or 40 per cent.—of the rainfall which falls upon its outcrop, passes into it. Several years ago a Royal Commission spoke in the highest terms of the deep well-waters from

the Chalk, which they described as almost invariably colourless, palatable, and brilliantly clear. They go on to say :—

Sources
of Water
Supply.

“The chalk constitutes magnificent underground reservoirs in which vast volumes of water are not only rendered and kept pure, but stored and preserved at a uniform temperature of about 10° C. (50° F.), so as to be cool and refreshing in summer, and far removed from the freezing point in winter. It would probably be impossible to devise, even regardless of expense, any artificial arrangement for the storage of water that could secure more favourable conditions than those naturally and gratuitously afforded by the chalk, and there is reason to believe that the more this stratum is drawn upon for its abundant and excellent water the better will its qualities as a storage medium become. Every 1,000,000 gallons of water abstracted from the chalk carries with it in solution, on an average, 1½ tons of chalk through which it has percolated, and this makes room for an additional volume of about 110 gallons of water. The porosity and sponginess of the chalk must therefore go on augmenting, and the yield from the wells, judiciously sunk, ought, within certain limits, to increase with their age.”

In the main this high opinion of the character of water from the Chalk is maintained by authorities at the present day, subject, of course, to certain considerations, which it is the object of this Report to discuss.

As the subject of Water Supply in the County involves a description of its water-bearing formations, it may be convenient at this point to give a brief account of the Geology of the County.

This report concerns itself mainly with the stratum which is to be found below the few feet of surface earth which sometimes covers the “formation,” and it will be understood, therefore, that the following description relates to what is called the *solid* geology of the County.

GEOLOGICAL FORMATION OF SURREY.

(Solid Geology.)

Geology of
Surrey.

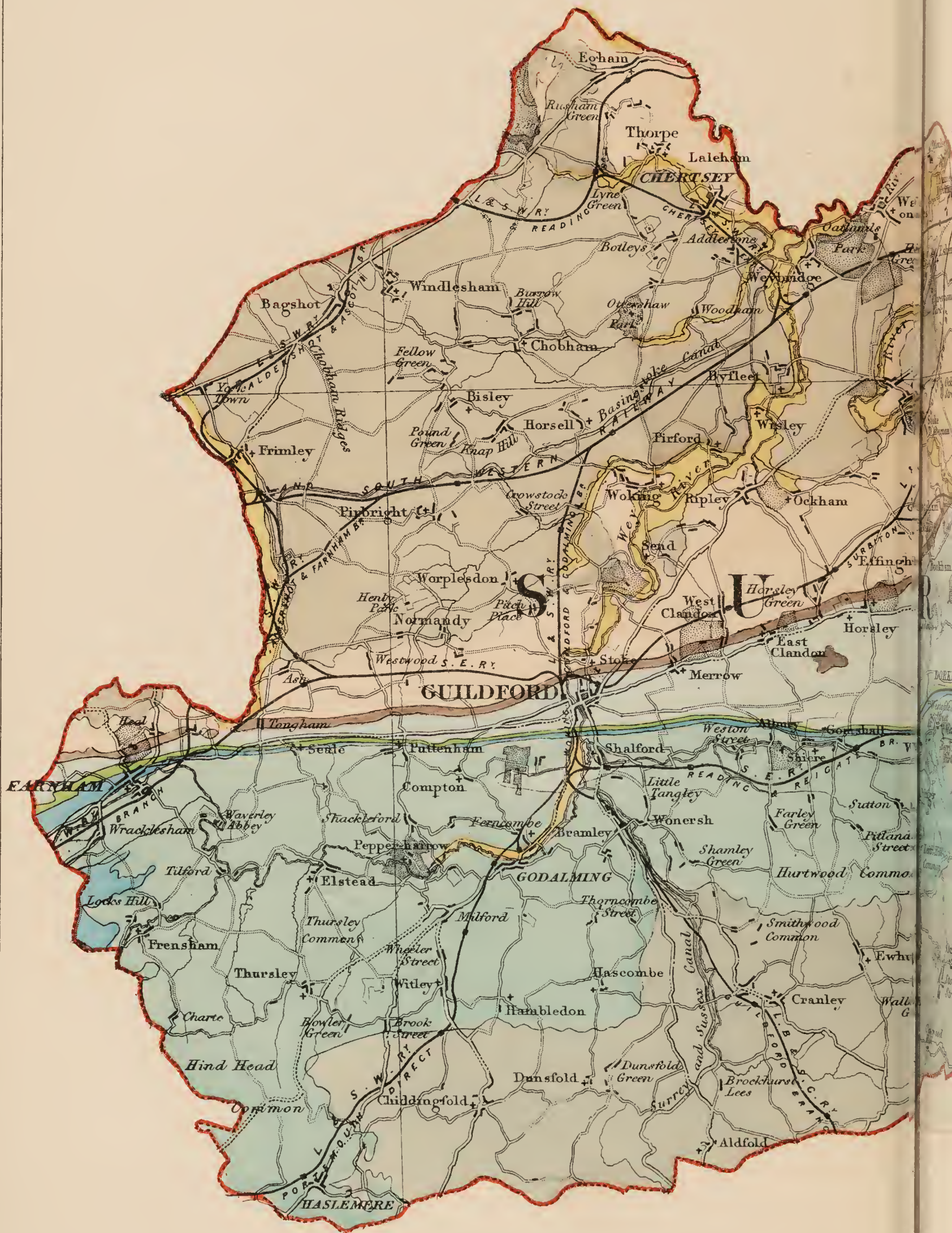
A geological picture of Surrey, taken from the Geological Survey Map, shows the County boundary roughly in the form of a square, the northern and western sides of which are very irregular. The area enclosed in this square may be said to be bisected by a thin dark brown streak (indicating the Woolwich and Reading Beds)—this is, as it were, trailed across the County from Farnham, through Guildford, Leatherhead, Epsom, Ewell, Sutton, and Carshalton to Croydon. Above, or to the north of this diagonal brown streak, lies the populous suburban area of the London Clay, and the Bagshot Sand district, which extends from Egham on the north to the village of Normandy on the south, and from Camberley on the west to Esher on the east.

South of this diagonal line is the cone-shaped chalk area, coloured palest blue, with its base between Croydon and Tatsfield, and its apex at Guildford, tapering away in the Hog's Back to Farnham. This pale blue area is, included between two streaks, namely, the diagonal dark brown one already mentioned on the north, and on the south a nearly horizontal streak equally narrow. This last named is coloured peacock blue, fringed with light green (to indicate the Gault and its border of Upper Greensand). These, together with the Chalk itself, form the upper cretaceous formation.

Below, or south of the horizontal line of Gault, is an area comprising about two-fifths of the county and about equally divided between the Lower Greensand formation and the Weald Clay, which belong to the lower cretaceous series. The Lower Greensand is the water-bearing formation, and it is this hilly, almost mountainous, area that forms some of the most picturesque parts of Surrey.

Looking at this southern parallelogram, it will be seen that the Lower Greensand area, like the Chalk area, forms a cone stretching

ADMINISTRATIVE COUNTY OF SURREY (SOLID)

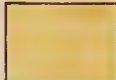
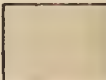
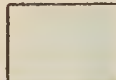




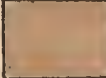




SURREY - GEOLOGICAL MAP.

(GEOLOGY)

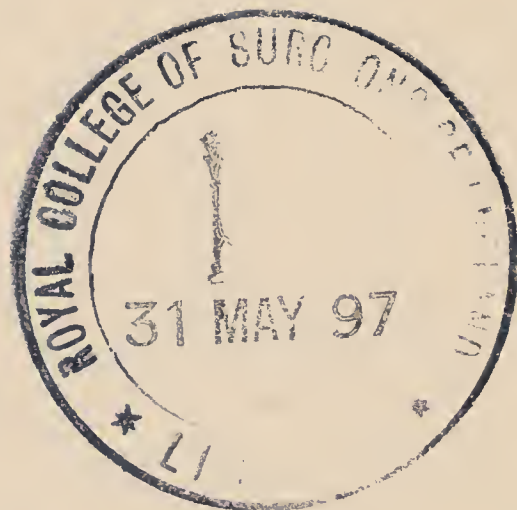
Prepared under the authority of the County Council, and by instruction of the Medical Officer of Health for the Administrative County of Surrey.



Lower Eocene.		Upper Cretaceous.		Lower Cretaceous			
	<i>Alluvium</i>		<i>Bagshot & Bracklesham Beds</i>		<i>Chalk</i>		<i>Lower Greensand</i>
			<i>London Clay</i>		<i>Upper Greensand</i>		<i>Weald Clay</i>
			<i>Lower London Tertiaries</i>		<i>Gault</i>		<i>Hastings Beds</i>

Scale of Four Miles to One Inch

0 1 2 3 4 5 6 7 8 9 10



right across Surrey, but in an inverse direction. It is broad in the south-western division, extending as it does from Farnham to Haslemere; it gets gradually narrower eastward until at Dorking it consists of little more than a narrow band comprised by the area of the town and its immediate precincts. It continues at about the same breadth to Bletchingley, Oxted, and Limpsfield. The situation of the Lower Greensand, with regard to other formations imposed upon it, or on which it is imposed, is exhibited in a simple form at Dorking. Descending from the high chalk hills on the north, the narrow belt of the Gault, fringed by the Upper Greensand, lies in the valley through which the stream known as the Pippbrook flows. South of the brook is the Lower Greensand, which extends through Westgate to Berryhill Park, where it meets the Weald Clay. The formations are, therefore, from north to south, exactly in the order in which they are imposed upon each other geologically. All the "beds" that lie south of the brook are also naturally beneath the chalk—that is to say, if chalk occurred in this district, it would have to be pierced to reach the lower water-bearing formation, just as in London the Chalk, beneath the tertiary beds, and the Gault, would have to be pierced in their whole thickness in order to reach the Lower Greensand—which (if it exists there at all) is very thin.

This Lower Greensand which lies beneath the Chalk attains a considerable thickness in the Isle of Wight—400 to 800 feet. But it thins away to the west and north. It appears to be almost absent under London. This water-bearing stratum has, however, a considerable thickness in the County of Surrey. The water-supplies of Farnham, Godalming, Dorking, Reigate and Oxted districts are wholly or partly derived from it. Where the source of the water is far removed from populous areas, as on the sides of Leith Hill, the water is remarkably pure and very soft. On the other hand, where dangers of underground sub-soil pollution exist, from the cesspools and sewers in close proximity to the wells, there is a risk which,

NOTE ON THE GEOLOGICAL MAP OF THE COUNTY OF SURREY.

It must be understood that the accompanying Map of Surrey refers to the *Solid* not the *Surface* Geology of the Administrative County. It is the *Solid Geology* that is of special interest in connection with Sources of Deep Well-water Supplies, which is one of the principal subjects of this Report. Many houses, situate within the areas of Public Water Companies, obtain their water supply from shallow wells sunk in the "Surface Soil," which may consist of gravel, sand, loam, &c. In certain localities this Surface Soil forms a more or less superficial covering of the stratum which constitutes what is called the *Solid Geology* of the district. Elsewhere (as for example on the Chalk Downs where the geological stratum is "*bare*") the "*Surface*" and "*Solid*" Geological Maps correspond.

considering the porous nature of the soil, can readily be understood and appreciated.

WATER SUPPLIES IN RELATION TO THE PUBLIC HEALTH.

Water
Supplies
in relation
to Public
Health.

It may be desirable here to summarise the points on which we have knowledge, either complete or partial. In the first place let it be understood that we are now discussing diseases which are *known to be* caused by drinking-water. That illness may be caused by insufficiency of water for domestic and drainage purposes is obviously a fact that does not need to be insisted on. Happily, the cases of notably insufficient water-supplies for large populations are rare nowadays, and those which have been reported lately have fortunately been unaccompanied or followed by any epidemic outbreak. Still, the likelihood of filth-diseases arising from such a cause as a deficient water-supply is ample reason for insisting at the outset on a reasonable quantity of water for use of every person daily as a prime necessity of health.

Admitting an absence or notable deficiency of water supplies to be a possible factor in the production of many states of illness, it must at the same time be plainly said that there is no sound reason for ascribing to water-supplies outbreaks of disease which have never yet been proved to be waterborne, even when such water supplies are condemned on account of their being notably inferior in quality. An epidemic of Smallpox or Diphtheria may be, and often is, used by responsible sanitary authorities as a cogent argument for incurring expenditure which on general grounds is rightly held to be desirable. But neither of these diseases is regarded by professional experts as waterborne, although there is plenty of assertion on the part of those who have not made the channels or methods by which diseases are spread their special study. With regard to Diphtheria, which is so frequently referred to as being caused by polluted water-supplies, there really has never been any such ground for the connection of the disease and the supposed cause, as many of those not

specially informed have been led to believe. Our knowledge on this point is thus stated by Dr. Thorne Thorne, C.B., F.R.S., Medical Officer of the Local Government, in the Milroy Lectures on "Diphtheria, its Natural History and Prevention," delivered before the Royal College of Physicians of London in 1891. Speaking of the relations of insanitary conditions to the prevalence of Diphtheria, he says:—"Dealing in the first instance with the influence of individual faulty circumstances, I would at once say that no trustworthy evidence is forthcoming to show that polluted water-supplies have ever caused Diphtheria; whereas, on the other hand, there is abundance of negative evidence in the opposite direction." We have yet much to learn about Diphtheria, and no one will, of course, regard the conclusions of workers in a comparatively new field of scientific observation as fixed and unchangeable; at the same time it must be remembered that this record of official opinion relates to the close and accurate study of a large number of epidemics by highly skilled independent men, and that it agrees with the statements in works on Hygiene by very experienced Medical Officers of Health. I wish to make it clear, therefore, that in speaking of waterborne diseases, I include only such as have been *proved* to be so conveyed.

Water
Supplies
in relation
to Public
Health.

WATERBORNE DISEASES.

There are certain diseases due to animal parasites which are contracted by swallowing dirty or unfiltered water. Worms such as *Ascaris lumbricoides* infect man in this way, their eggs being usually carried into the stomach by water. Both in England and elsewhere the prevalence of round worms has been observed in districts where the inhabitants have been obliged to resort to polluted ponds or shallow wells for drinking-water. More dangerously, but probably more rarely, man is infected in this country by the *Tænia Echinococcus*. This parasite in the tapeworm stage belongs to the dog. The ova may easily find their way into

Waterborne
Diseases.

Waterborne
Diseases.

water, and so, through the stomach, may be taken into the human system, where they develop in what is known as the Hydatid stage, and give rise to tumours which may be very serious in their results. Hydatid tumours are common in Iceland, parts of the Continent and Australia, but rare in England.

The contraction of the disease known as Goitre (a glandular swelling of the neck) is said by good authorities to be due to drinking certain waters, and it is believed that the effect is produced by some one or more of the mineral constituents of the water, although the Goitre-producing substance has not as yet been identified.* This effect on health is associated with certain kinds of hard water, and is very limited in its operation. Far more diffused is the influence of certain kinds of upland (very soft) waters, by which lead is readily dissolved and carried. In Sheffield and other neighbouring towns there has been trouble due to the action of the upland water on lead pipes and cisterns. It has been estimated on the best authority that about half a million persons in the West Riding of Yorkshire alone are liable to lead poisoning by drinking-water which ranks high as regards organic purity, but which possesses the property of dissolving the lead of the service pipes and carrying it in solution.

Waters containing an excess of mineral constituents may cause dyspepsia and affect the mucous membrane lining the alimentary canal, sometimes producing diarrhœa. Turbid river water and water containing vegetable *débris* is said to have the same tendency, especially in the case of those who are unaccustomed to the water. But it must not be supposed that the autumnal diarrhœa, so prevalent in certain districts, and which forms a considerable item in the mortality every year, especially among infants, has any connection with the water supply. Several years ago I had the opportunity of observing and noting in the prevalence of this

* *Vide* Thresh on "Water-Supplies." Rebman Publishing Co., London.

disease its entire independence of the character of the water-supply. The experiences of Leicester and other towns have been very instructive in this respect. Insufficiency of water supply may promote the spread of the disease by the non-removal of dirt, but it is doubtful whether in any other sense it can be said to be a waterborne disease in this country; that is to say, so far as its prevalence is capable of being estimated by the death rate or otherwise.

Waterborne
Diseases.

The two great waterborne diseases are Cholera and Typhoid (Enteric) Fever. The last named is *the* waterborne disease in England, and indeed so universal and well founded is the belief in the spread of Typhoid by sewage-polluted waters that, in anticipation of the possible advent of Cholera, its varying prevalence in different counties and parts of counties has been used as a reliable index of the safety of their water-supplies. Well-known authorities, such as Dr. Stevenson, the Home Office and County Analyst, and others whose opinion is of the highest value, in treating the subject of water, speak of the practical elimination of Typhoid in England as entirely a question of the purity of water supply.

Inasmuch as I shall have to discuss in this Report points which involve the foundations of the belief or opinions just stated, it may be desirable to examine somewhat closely the character of the evidence or proof on which they are based. Epidemics of Typhoid Fever due to specifically polluted water (or to milk believed to have been contaminated with polluted water), of which epidemics there have been quite a large number, have been for the most part traced with great accuracy, and in such a way as to amount to a complete demonstration of the cause. It was the fact that these conspicuous outbreaks were traceable with certainty to their origin, coupled with the many plausible suggestions that for every outbreak demonstrated there were a hundred not capable of being demonstrated, that naturally led to the assumption that polluted drinking water

Waterborne
Diseases.

accounted for Typhoid prevalence in England. This seemed all the more likely, because in South Germany, where the cause of Typhoid had received the attention of eminent authorities, the official view (expounded by Professor Pettenkofer and his followers) was equally explicable on the English official view of the waterborne character of the disease. These last-named official opinions were generally held in 1872, when the practical work of sanitation in various parts of the country received a great impulse by the appointment of Medical Officers of Health. For my own part I shared the prevailing opinion strongly, and reported against a water supply in 1873, in the full belief that an outbreak of Typhoid Fever could not have been caused in other ways.* Subsequent experience, however, of the effect of sanitary improvements other than those connected with water supply, which, as a local Medical Officer of Health, it was my duty to observe closely, led me to modify an opinion which was based on the work and observation of others working under different and exceptional conditions. In 1879 I recorded the conclusions from those experiences at a Conference under the then President of the Local Government Board.† At that time it had become evident to me that the persistence or endemic prevalence of Typhoid year after year, in districts which I knew to be above suspicion as regards purity of water supply, was incompatible with the assumption that Typhoid was wholly, or almost wholly, waterborne. The further fact that this endemicity or persistent prevalence subsequently disappeared, apparently under the influence of improvements in sanitation (consisting mainly in the control of excremental or filth nuisances), quite unconnected with water-supplies, supplemented the negative evidence by that of a positive character. I was thus led with others to think that much

* *Vide* Report on the Sanitary Condition of the Borough of Nottingham, in 1873, by the Medical Officer of Health (pp. 14—20).

† *Vide* Journal Society of Arts, 1879.

of the reduction of the Typhoid death-rate, which has taken place of late years, has really been due to other sanitary alterations, although generally attributed to improvements in water supplies.

The reduction in Typhoid Fever in England and Wales is shown by the Table taken from the recently issued Supplement to the Fifty-fifth Annual Report of the Registrar General. The figures there given by Dr. Tatham are as follows :—

Quinquennia.	Death-rates per million.
1871-75	374
1876-80	277
1881-85	216
1886-90	179
1891-94	135

This steady reduction in the Typhoid death-rate is gratifying evidence of the value of sanitary measures which have been in progress more or less throughout the whole country during the past quarter of a century. But marked as it has been, it might, I think, have been expected to have been still more marked had impurity of water supply been the great main factor determining the presence of the disease. This point becomes more clear if a close study be made of the Typhoid death-rates of large towns which, within the period referred to, have had provided water-supplies above the slightest suspicion as regards organic purity, and who have compelled the substitution of pure water from the public supply for any water open to the slightest suspicion of contamination or pollution. In such cases the practical extinction of Typhoid might have been looked for if it were wholly a waterborne disease. I have referred before to the town of Nottingham, population 200,000, with the sanitary circumstances of which I was intimately acquainted, and with regard to which I held official responsibility for several years. I would add that the experiences of other large towns of whose systems of water-supply and sanitation I have had knowledge for several years, seem to point to the same conclusion.

I have further remarked that although others write in the same sense as my colleague Dr. Stevenson, they all mention in illustration of their contention the case of small towns, in which the introduction of a pure water supply has been followed by the disappearance of Typhoid. Now that we have in the Administrative County of Surrey a complete system of notification and issue of monthly summaries, it would be easy to show from our own experience that deductions or inferences of this kind are apt to be very fallacious in the case of small populations during short periods of time.

Waterborne
Typhoid.

On the whole, therefore, in the absence of evidence which I think must be regarded as essential, I am inclined to think that the waterborne hypothesis does not by any means wholly or nearly wholly account for the prevalence of Typhoid in the counties and towns of England. This hypothesis I well remember the late Sir William Gull characterised as "a good working hypothesis," presumably meaning thereby that contamination of water supply was a sanitary fault, the remedy of which demanded the best attention. There is, of course, no possibility of doubt as to the fact that Typhoid is carried by water. It is the *extent* of this causative influence that is in question. Whether water infection accounts for something like 90 per cent. of the cases of sickness from this cause, or whether it accounts for no more than some 20 per cent. or 30 per cent., is clearly a question of the greatest practical importance, not only as determining the kind of work which is most likely to be effectual from the preventive point of view, but incidentally also as affecting the precise significance of Typhoid death-rates, regarded as indications of imperfect sanitation of different kinds.

I must not omit to point out here that water used for drinking purposes may derive its infection otherwise than from the source, viz.,—whilst in course of distribution or storage. This method of

deriving infection by the insuction of foul matter into water mains and service pipes is one which those who inquire into Typhoid outbreaks must always bear in mind. This is a danger which the late Sir George Buchanan demonstrated by the most remarkably complete proof in the case of an outbreak at one of the Cambridge Colleges about twenty years ago. His report has always been referred to as a typical example of exact investigation of the kind for which the Medical Department of the Local Government Board has long been famous. Dr. Buchanan also did much to explain the exact physical conditions which made insuction possible. He was, I know, much impressed with the need for further investigations in this direction. Other reports have been published showing how water may become the carrier of infection in this way. But they are few in number. It is true this fact has been explained by the acknowledged difficulty in detecting or tracing such outbreaks; still, it must be remembered that many Medical Officers of ability have been keenly on the look-out for the possibility of such occurrences for a long time, apparently without result. Nevertheless, this particular risk to water-supplies must not be lost sight of.

Waterborne
Typhoid.

Other means of contamination of drinking water-supplies in cisterns must of course also be taken into account when estimating the extent to which Typhoid may be said to be a disease caused by infected water (or milk infected in some way through water).

But dangers to water-supplies of the kinds just mentioned obviously belong to a different class than that which concerns the purity of water at its source. Moreover, these come within the sphere of different branches of administration.

This leads me to remark that other work of sanitary administration besides the conservation of water supplies may exercise a potent influence in determining local prevalence of Typhoid.

Cause of
Typhoid.

Foremost amongst these I should place the prevention of excremental and other filth nuisances, such as those arising from manure and offal; the construction of privies, water closets, drains, cess-pools; the cleanliness and dryness of dwellings, especially as regards their foundations and the soil on which they stand; and last, but not least, the destruction by burning or the disinfection by sufficient doses of perchloride of mercury, of all infective discharges of the sick. These precautionary measures can only be expected under a strong Sanitary Authority, and where constant and effective sanitary supervision is also maintained.

TYPHOID IN THE ADMINISTRATIVE COUNTY.

Typhoid in
Surrey.

My own knowledge of the County in this respect dates from the period when I commenced to receive the Reports of the 33 Sanitary Authorities on behalf of the Council in 1890. Year by year I have tabulated the death returns in the Reports which I have had the honour to make to the Council, after careful correction and adjustment of the figures by elimination of deaths belonging properly to other localities, and inclusion of those with which the locality reported upon ought properly to be credited. In this way the actual Typhoid death-rates of the County have been estimated with sufficient accuracy. For although the term "Fever," under which all forms of Continued Fever are classed, includes "Typhus" as well as "Ill-defined Fever," the inclusion of these under the generic title "Fever" does not constitute a serious source of fallacy. The first-named "Typhus" has been absent, the term "Continued Fever" being frequently used to designate mild cases of Typhoid. So that the generic title "Fever" is practically identical with that of the species Typhoid. The Fever rate therefore of the County is strictly comparable with that of the Registrar General's for England and Wales. It is thus set forth in the following Table, the figures being brought up to "rates per million"

for the sake of easy comparison:—

Administrative County of Surrey.		England and Wales.		Typhoid in Surrey.
Deaths per million persons.		Deaths per million persons.		
Years.				
1889.....	100	} Av. 75	1885-90 Av. 179	
1890.....	50			
1891.....	60			
1892.....	65	} Av. 79	1891-94 Av. 135	
1893.....	105			
1894.....	85			
1895.....	70	Av. 70	not estimated.	

From the above table it will be seen that the Administrative County compares favourably with the whole of England, the rate of mortality being less than half the last estimated average of the whole country. Apart from questions of Sanitary Administration it would be naturally expected that the mortality of Surrey would be considerably below the All-England rate. For although Typhoid, unlike Measles and some other diseases, is not specially remarkable for its fatality among the poor, or influenced by conditions which social status connotes, yet, in common with almost every disease, it is affected by density of population. In this respect, of course, the population of Surrey would be advantageously situated as compared with the mass of the population which congregates in the large towns. So that the mortality might naturally be expected to be below the average, provided ordinary sanitary supervision were exercised. That it is less than half the All-England average is evidence that such care has been well provided. But the disease persists to its present extent, viz., an average of 75 per million, representing annually for the whole population of Surrey some 30 deaths, or in other words some 300 cases of sickness, often among breadwinners, each of which attacks of illness may be taken to last some six weeks. This cannot be other than a matter of dissatisfaction, and it is desirable therefore that the causes of this persistence should be thoroughly gone into so that if possible they may be mitigated or removed.

Typhoid in
Surrey.

There has been no extensive outbreak in Surrey during the time I have known the County officially, 1890-96. I have been, since I became Medical Officer, gradually referred to or consulted more and more in the case of outbreaks of Typhoid and other infectious diseases. Those which I have investigated in the County include three Typhoid outbreaks of somewhat larger proportions than what usually occur.

The first of these was at Richmond in 1892. It was, I believe, due to faulty arrangement of supply pipes to closets, by which insuction took place into the water mains. These defects were directly remedied at my suggestion.*

The second was at Caterham Asylum and Barracks in 1894. This comparative small outbreak is not to be confounded with what is known as *the* Caterham Epidemic of 1879, referred to at p. 65. That epidemic has attracted much attention since, on account of its lesson. Two hundred cases immediately arose from the specific pollution of a water supply in a most disgusting manner. This was unmistakably due to the water supply. In the absence of satisfactory evidence to show how the contamination took place, I am disposed to think that this outbreak was caused by the wanton mischief of a lunatic of filthy habits.

The third was at the St. Peter's Home, Woking, in 1895. This last outbreak was very carefully investigated by Mr. Lake and Dr. Howlin, and reported on by the former. The report is on the Minutes of the January Sanitary Committee Meeting. It is also published as a contribution from Mr. Wellington Lake in the volume for 1895 of St. Thomas's Hospital Medical Reports. This case is an excellent illustration of the fact that considerable outbreaks of Enteric Fever may arise quite independently of conditions of water supply.

The total number of cases in these three outbreaks, occurring during five years, was just about 100. It may be estimated that in five years of Average Typhoid prevalence, there would occur some 1500 cases in the whole county. The great majority of the cases

* The evidence relating to this outbreak was before the Sanitary Committee at the time. Other District Authorities would do well to take note of the possible existence of like defects which formerly were common enough.

occur in small groups, or sporadic (solitary) cases, the origin of which is not yet fully understood. Typhoid in Surrey.

Within the last two years we have completed in Surrey the system of Notification, which has been adopted in every district, by the circulation of Monthly Summaries of Notification Returns. The value of this "Summary" is apparent in many ways. One of its most useful objects is that of apprising us of any exceptional prevalence of Typhoid in any particular locality or district. In this way I have come to have a more intimate knowledge of the local prevalence of Typhoid, and I have been more frequently in communication with the Medical Officers thereon. As time goes on, the Medical Officer for the County may expect to have opportunities of giving advice about outbreaks of Typhoid at an early stage, when preventive measures are most likely to be efficacious. It also should enable us to take stock of the situation from time to time, and, by comparison of the rates of sickness in districts where the sanitary circumstances differ, to obtain a clue as to the underlying causes of illness of this kind in particular localities. I propose to keep records and maps for the use of the Committee, showing periodically the relation of Typhoid attack-rates to the character of the water supplied and used in each district and in each case. This will be a very valuable record.

Although the Surrey District Rates for the last two years are favourable on the whole, I apprehend that, inasmuch as many places in Surrey are "Health Resorts," which it is of great importance to keep free from such a preventible disease as Typhoid Fever, the Council will never be satisfied until the Fever rate has been reduced to a minimum. This cannot be done until such Authorities as that at Farnham realize their responsibilities in the matter of the prevention of disease. This town, since I have known it officially, has always come out badly as regards the prevalence of Typhoid Fever. I am also aware, from inspections with the Medical Officer of Health, that the reason of this prevalence is easily explained, and clearly has no connection with public water

Typhoid in
Surrey.

supply, which is excellent and easily available. This is a conspicuous example of the way in which, through bad sanitary administration in the past, a public water supply, which is really very good, may suffer suspicion if the health statistics of the District be taken to indicate the character of its public water-supply.*

My inquiry into the prevalence of Typhoid in Surrey in connection with water-supply up to this point related to sickness or attack-rates. It then occurred to me that it was possible to apply a further test of the relation of Typhoid prevalence to the area of distribution of water derived from the chalk formation. The reduction of Typhoid death rates has been conspicuous throughout England during the period 1874—1894. Surrey has shared in that reduction. Taking certain Districts supplied with water from the chalk in the County, and comparing them with Districts otherwise supplied, is there any conspicuous difference in their behaviour as regards the reduction of Typhoid? If so, is the difference apparent rather than real?—that is to say, does it depend on different nomenclature of diseases or different systems of classification of deaths?—for we are dealing now with deaths, and not sickness. In such case, are there differences in administration which might account for the difference in the Typhoid death rates?

It is plain that in the districts for which my colleague Dr. Jacob has been Medical Officer since 1874, the conditions of comparison *do* exist. In the first place, he always enquires into and reports on cases of fever and sickness with scrupulous care; he invariably includes the cases that belong to his districts, although when ill they may have gone into a hospital outside; and he also takes care to exclude cases at public institutions which do not belong to his districts:—all this on a uniform system. The figures of his several districts are, therefore, strictly comparable, even if we go back as far as 1874. Now, certain groups of his districts may be arranged according to the prevailing character of their water supply. One district, the Chertsey Union, which included Weybridge and Walton, has mainly a river water supply, supplemented by

* Refer to page 32 of this Report.

shallow wells. Another district, the Dorking Union (Dorking Town and villages round), abandoned its supply some twenty years ago, and is now mainly supplied from the Lower Greensand sources, at a distance from the population, a very small part of the population being supplied from the Chalk. In a third District, the Reigate Union, consisting of Reigate Borough and the small towns or villages around, the population is largely supplied from the Chalk; and in a fourth, the Sutton, Carshalton, Leatherhead and Epsom District (comprising the old Epsom Rural District), the water supply is derived almost entirely from the Chalk. The populations of these Districts, and the Typhoid death-rates per 1,000 persons, estimated approximately, were as follows. The figures here given are by Dr. Jno. Williamson, M.D. Lond., who is acting as Dr. Jacob's assistant for the United Districts:—

Typhoid in Surrey.

The two periods of ten years, 1876 to 1885 and 1886 to 1895, have been taken for comparison; in these periods the populations at the census do not differ greatly from the mean population. In the table the numbers of deaths have been taken from the Annual Reports; all cases of "fever" are included.

TABLE I.

Name of Union, Parish or District.	Population at Census.		Number of Deaths in the Ten Years.		Approximate Death Rate per 1000 for 10 Years.		Reduced by
	1881.	1891.	1876-85.	1886-95.	1876-85.	1886-95.	
Chertsey (Union)	27,137	32,772	65	27	2·4	·8	About $\frac{2}{3}$.
Dorking (Union)	15,460	17,223	29	8	1·8	·46	About $\frac{3}{4}$.
Epsom (Union) ..	41,261	50,124	45	24	1·1	·48	About $\frac{1}{2}$.
Reigate (Union)	30,359	36,580	43	16	1·2*	·53	About $\frac{1}{2}$.

*Caterham Outbreak (of 1879) included.

Typhoid in
Surrey.

Dr. Williamson has given me, in addition, a number of notes as to local investigations of cases of fatal Typhoid during the period 1886-95, which are very valuable.

The inferences to be drawn from the exhaustive inquiry on which we have been engaged for nearly a year are that: (1) There has been a marked diminution of Typhoid shared in by all Dr. Jacob's districts; (2) That it has been more marked in the districts deriving their supplies from the sand and river; but that (3) The figures relating to deaths are small, and do not admit of any decisive conclusion; (4) That by careful comparison of the attack rates and other local circumstances, which our improved sanitary organization now renders possible, we shall be enabled to keep a good look out in the future.

So far as Chalk water-supplies are concerned, then, it seems impossible to show that there has been any evidence of their having produced any notable ill effects as regards Typhoid.

But their hardness is, in some respects, a disadvantage, and it has necessitated processes of softening, which will be described further on.

In the meanwhile, before leaving this subject of Typhoid in the County, I must draw attention to a conspicuous illustration of the dangers of underground pollution of water supplies in porous or fissured strata. This illustration is drawn, however, not from the Chalk, but from the Lower Greensand.

The past history of the Dorking Town and country district exhibits a remarkable reduction in the prevalence of Typhoid Fever. Comparing the prevalence during the last ten years with that of the previous decade, the reduction cannot have been less than 70 per cent.

I am indebted to Mr. Somers Scott and Mr. Rossiter, of the Dorking Water Company, for part of the subjoined information.

The Dorking Water Company was incorporated by Act of Parliament in 1869, the limit of supply being the Parish of Dorking. ^{Dorking Water Supply.} The works then consisted of the water wheel and engine house near the brook, with an adjoining reservoir (or more properly, pit). The brook is crossed by the path from the S. E. R. Station to Dorking Town, and the old water works are to be seen beside the path. A system of small, very old mains, which only reached the older streets of the town, and a partly constructed reservoir built on ground the property of the contractor, constituted the rest of the plant. It will be understood, therefore, that the source of supply was situated in the valley of the Pippbrook, at the foot of the slope of the Lower Greensand on which Dorking stands.

I have investigated the subject of this source of water supply as much as possible, and I believe that there can be little doubt that the source of this water supply was liable to pollution both under- ^{Reduction of Typhoid following Improved Water Supply.} ground and above ground. In either case the mode of pollution is easily intelligible and does not call for any far-fetched explanation. Indeed, it would have been strange if water derived from a spongy soil situated in a town (which, in common with almost all other towns, a quarter of a century or so ago, was honeycombed with cesspools and leaking drains) should not have become polluted. From what Mr. Rossiter tells me, there were very likely other possible sources of pollution in the reservoir itself, which may, indeed, occasionally have been fed direct from the brook.

In thus connecting the Typhoid prevalence with the old public supply, I must not omit to mention that, having lately had the advantage of conferring with Dr. Chaldecott, whose knowledge of the medical history of Dorking is, of course, unrivalled, I have learnt from him a noteworthy fact. It is that the cases of Typhoid did not occur as "outbursts" or "explosions" (a number of persons failing simultaneously). This is a general characteristic of water epidemics, and its absence therefore requires to be noted.

Dorking
Water
Supply.

It was, however, during the period that this source of supply was in use that Typhoid was so prevalent. It was, moreover, the prevalence of Typhoid that led to its abandonment.

Acting on the advice of Dr. Pole and Professor Prestwich, a well in the Greensand near Tower Hill was sunk, and a system of new mains laid to all parts of the town. When the new supply came into general use Typhoid, which had been prevalent for some years, diminished remarkably, *vide* Dr. Jacob's reports.

Since 1872 further supplies from the Lower Greensand in the open country have been acquired—viz., from the Rookery Estate, the Redlands (1880 and 1887), Westcott (1895), and Deepdene (1896).

It is since the provision of these pure water supplies, and their general substitution for those which were impure or liable to contamination, that Typhoid has so remarkably diminished.

SUPPLIES FROM THE LOWER GREENSAND.

The present situation of the sources of water supply for Dorking is nearly perfection, so also are those of some other districts in the County, Cranleigh and Limpsfield to wit, while those of Farnham, Godalming, and Reigate are sufficiently remote from populous areas.

Lower
Greensand
Supplies.

But there is one district in the County, not as yet resorted to, which seems to me to offer unrivalled facilities for the collection and distribution of an abundant public water supply of the same excellent quality as that just noted. I refer to the Forked and Hammer Pond region, so well known to those who visit the picturesque neighbourhood of Hindhead. I have had the privilege of seeing reports made by eminent experts on the water-supply resources of this region at commanding heights, and it would appear to me that the capacity of this water-bearing area is large as compared with others in the County, and that, in view of the rapid increase that is likely to take place in the parts of West

Surrey, the probability of its utilization, by arrangement with the existing owners, is a subject of wide public interest.

Lower
Greensand
Supplies.

One of the chief characteristics of the Lower Greensand Waters is that, as a rule, they are soft and pleasant to use. The Chalk waters are of course naturally hard, and need to be artificially softened. Where, as in the supply of some companies (East Surrey to wit), the Greensand Water is mixed in varying proportions with the chalk water, the natural hardness of the resulting supply is correspondingly diminished. I find on inquiry at Reigate that no disadvantage attends this mixture of waters. On the other hand there would, I think, be much benefit to the population of other districts who rather complain of the hardness of their supply, which is wholly from the Chalk.

WATER SOFTENING.

The hardness of water from the chalk is due to the soluble Carbonate of Lime—*i.e.*, the Bicarbonate of Lime. This “temporary hardness,” as it is called, may be got rid of either by boiling or by addition of Lime in solution in suitable quantities.

Water
Softening.

The process may be seen in operation at the Kenley Works of the East Surrey Company, where it has been carried on for some years now continuously at a moderate cost, and as far as I can learn with uniform success. Care and attention by skilled and reliable persons are necessary in order that an excess of lime be not added, since it is somewhat soluble in water, *and any excess present will again increase the hardness*. The original process, as patented by Dr. Clark, appears to me to be the simplest and the most efficient of the “Lime Processes,” and it is the one almost universally adopted. The essential thing is to secure intelligent and thoroughly reliable supervision, so that the right quantity of lime is added.

Water
Softening.

It is said on good authority that during the process of softening, the microbes contained in the water suffer a considerable decrease in number, these organisms apparently becoming entangled in the precipitate formed and settling therewith to the bottom of the tanks in which the softening process takes place. In the case of a suspected chalk water-supply this might, perhaps, be regarded as an additional advantage in the process. But in the example given, the softening process was adopted some time ago, before the value of bacteriological research was understood, and for the sole purpose of giving the consumers a soft and pleasant water to use. I believe I am warranted in saying that, softened as it is with moderation and care, there have been no disadvantages experienced, and that the inhabitants of the part of Surrey in which it is in use would not be willing to go back to the former condition of things.

WASTE OF PURE WATER.

Waste of
Pure Water.

In speaking of possible or rumoured deficiency of water supply there is one aspect of this subject which seems to demand special attention: it is the reckless waste of water of high organic purity, obtained at expense of pumping from deep subterranean sources. Such water being, moreover, sometimes treated at additional expense in order to soften it artificially, and make it more suitable for domestic or trade purposes. That water of this kind should be used for watering and flushing when the waters of rivers and shallow wells would answer such purposes equally well, surely seems to be a most unnecessary waste. The separate uses of different kinds of water seems urgently to require attention. In this connection I may mention that in some places the service of pure softened water is confined to purposes for which there is decided advantage in its use, other inferior water being made to serve the purpose of cleansing, flushing, and watering.

AREA AND POPULATION SUPPLIED FROM DIFFERENT SOURCES.

Before proceeding to the discussion of the quantity and quality of the river water supplies, a few words may be said on the subject of the area and populations supplied from the cretaceous formation (*i.e.*, the Chalk, the Lower Greensand), and the Bagshot Sands. The area and distribution of their supplies will be shown by maps, which will accompany this Report. It will be seen that the area of the public water supplies from the chalk extend over a large part of the County, and that the population comprised in the area of supply may be approximately estimated at 150,000. The waters of the Greensand supplies are not so large at present, and their population, which is more sparse, may be estimated as approximately 50,000. If the Thames Valley and the neighbouring population of the County, which derives its supply from the river, be estimated as approximately 200,000, then the total population provided for by public supply would be 400,000. The remainder would represent areas and populations outside the source of public supply. In the course of time we may expect to have exact knowledge of the system of water supply to every house in the County.

As touching the question of the sufficiency of our water supplies, as regards quantity, I may, in this place, refer again to the abundant and, it is hoped, available supply in the region of Hindhead. I may also remind you that one of the County River Companies have a very large reserve supply, inasmuch as they do not draw a fourth of what they are entitled to from the Thames. With these reserves I should think that the County, as a whole, is sufficiently well off.

Areas and
Populations
supplied
from different
sources.

NOTES ON THE MAP SHOWING THE AREAS OF THE SEVERAL COMPANIES' SUPPLIES.

The object of this Map is to show at a glance the source of the prevailing public water supply of a district, and its distribution (reservoirs and chief mains). It will be understood that the map relates only to water supplies from the sources acquired by Public Companies. A certain proportion of the population (not yet, except in the case of the Croydon Rural District, exactly estimated) in the areas of the several Metropolitan and County Water Companies derive their water supply from local wells. In some districts these are sunk in a different formation from that which furnishes the source of public supply. Thus, for example, the area of the Woking Water Company (the source of whose supply is from the chalk formation near Horsley and Clandon) includes a large tract of country consisting of the Bagshot sand formation. The character of the water yielded by these two formations—the Chalk and the Bagshot Sand—is of course very different. Again, Greensand Water is carried into Chalk Districts and *vice versa*.

It must further be noted that there are some districts—viz., Richmond, Croydon and Reigate, the public water supply of which, being derived from different sources, is of a mixed character. At Richmond, for example, it is partly derived from a River source, partly from the Chalk formation beneath the London Clay, partly from the Gravel, and partly from the Oolite and Deep Sandstone formations. This variety of sources is, in the case of Richmond and Croydon, indicated by variety of colours representing the different supplies. In other cases, such as the supplies of the East Surrey Company and the Godalming Company, it has not been possible to indicate this mixture of supplies on the map. In the case of the first named (East Surrey Company) about five-sixths of the supply is from the Chalk formation, but a certain proportion (varying in quantity according to the season of the year and levels of ground water) is derived from the Lower Greensand. The relative hardness of the water supplies depends to some extent on the proportions of the water derived from the different sources.

N.B.—The areas coloured *green* on the map are supplied with water from the River Thames by the following Companies—viz.: 1, Lambeth; 2, Southwark and Vauxhall; 3, West Surrey; 4, South West Suburban.

The areas coloured *pink* are supplied with water from the Chalk formation by the following Companies—viz.: 1, East Surrey; 2, Warlingham; 3, Sutton; 4, Epsom; 5, Leatherhead; 6, Woking; 7, Guildford.

The areas coloured *yellow* are supplied with water from the Lower Greensand formation by the following Companies—viz.: 1, Oxted; 2, Dorking; 3, Cranleigh; 4, Godalming; 5, Farnham.

The area coloured *brown* indicates the water supply of the Frimley Company, which is derived from the Bagshot Sand formation.

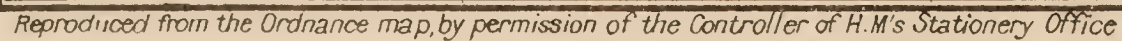
RIVER WATER SUPPLIES.

River Water
Supplies.

I now come to the subject of river water supplies in relation to the public health of the County. Although it has been shown that extensive areas in Surrey are supplied with water from either the Chalk, Greensand, or Bagshot sand formations, the



SHOWING THE AREAS OF TI SEVERAL



OF SURREY - WATER MAP

OF THE SEVERAL COMPANIES' SUPPLIES

Prepared under the authority of the County Council, and by instruction of the Medical Officer of Health for the Administrative County of Surrey.



AREAS

RIVER WATER COLOURED GREEN
 CHALK WATER " " PINK
 LOWER GREENSAND " YELLOW
 Richmond and Croydon supplies
 are of a mixed character.
 Uncoloured Areas are outside the
 supplies of Public Water Companies.

Scale of Four Miles to One Inch

0 1 2 3 4 5 6 7 8 9 10



population of the County so supplied is numerically no larger than ^{River Water} that which derives its water from the Thames, from which, also, ^{Supplies.} the chief part of the London water supply is drawn. The questions, therefore, which have been raised by the Reports of the London County Council during the last year, and which have been so much discussed in the public and expert press, directly concern the inhabitants of the County. I myself have given great attention to the question, and have had the advantage of conferring, at Oxford and elsewhere, with some of those who are best qualified to give independent scientific evidence on this subject. I will proceed, therefore, to the discussion of the subject, which, under the head of the "Purity of the London Water Supply," has lately given occasion for a searching review of the existing state of scientific knowledge, the tests and proofs respecting the indications of impurity, and the effects of impure water in relation especially to Typhoid Fever.

CHEMICAL ANALYSIS: ITS SCOPE AND INTERPRETATION.

It is fitting that a few remarks should be offered upon this ^{Chemical} subject in the present place, inasmuch as what has been ^{Analysis.} written and said lately in public with regard to the water from the Thames relates, of course, equally to all drinking water, from whatever source it is derived. It is in order to clear up misapprehensions which would naturally arise amongst those who have not made this subject their special study, that it will probably be considered useful to enter into it somewhat fully.

Avoiding technicalities as far as possible, I will endeavour to make clear the main points which it seems to me important to bear in mind, in order to prevent confusion of thought in considering apparently contradictory statements of experts both in chemistry and bacteriology.

In the first place, all water, from whatever source, contains inorganic matter and organic matter in infinitesimally small

quantities. It contains also living organisms. It is the proportion of the inorganic and organic matters and the number of the organisms which has formed the chief subject of debate.

As regards the inorganic constituents of water, it can easily be determined whether they are in quantity or quality objectionable, and upon this the Analytical Chemist, if he knows the physiological action of the salts, is quite competent to express an opinion. But it is seldom in the case of waters containing inorganic matters in such quantities as to affect health that the Chemist is referred to for a decision as to their potability.

What the chemist is called upon to estimate, as a general rule, in drinking water, is the quantities of inorganic salts in solution such as are either natural to the water or have become added to it by the pollution or decomposition of animal or vegetable matter. He is also called upon to estimate the proportion of the organic matter itself. It must be understood that these materials, inorganic or organic, are present in extremely minute quantities even when said to be "excessive." They, require therefore, as a rule, the most delicate processes of analysis such as can only be carried out by special experts in perfectly equipped laboratories. The inorganic matters usually estimated by the water analysts are the proportion of chlorides; the nitrates and nitrites; the ammonia; and the phosphates. These are estimated sometimes in the proportion of parts per gallon (70,000 parts of water), but now much more frequently, for the sake of uniformity, in parts per 100,000, or better still, a million. The organic matter is generally estimated by the proportion of what is called albumenoid ammonia per million parts of water, or it is estimated by the amount of oxygen absorbed per million parts of water.

INORGANIC MATTER.

Chlorides.—The quantity of chlorides present naturally in water varies according to different geological formations. Their amount

is, as might be expected, also influenced by the proximity of the soil from which the water is derived to the sea. Rain water, especially in districts near the sea, always contains a trace of salt. Thus, for example, the water contained in chalk wells in the Isle of Wight might be expected naturally to contain a larger proportion of salts of chlorine than that from a chalk well in Surrey.

It is necessary, therefore, to know beforehand what is the amount of chlorides naturally present in the water of a district. Given that information, the amount of chlorides present may serve as a rough but very useful index of the extent to which the water may be contaminated by sewage.

As a rule the value of the estimate of the chlorides in water supplies is only in its relation to the other constituents.

Nitrates and Nitrites.—Organic matters contained in sewage, and therefore of animal origin, yield nitrates after percolation through suitable soils. Upland surface water, as the Rivers Pollution Commissioners reported, “in contact only with mineral matters or with the vegetable matter of uncultivated soil, contain, if any, mere traces of nitrogen in the form of nitrates and nitrites, but as soon as the water comes in contact with cultivated land, or is polluted by the drainage from farm houses or human habitations, nitrates in abundance make their appearance.” On the other hand, some deep well waters, especially chalk, contain a considerable amount of nitrates which it is suggested have been derived from fossil remains or natural deposits of nitrates. Even in chalk wells, the proportion of nitrates varies very remarkably. Apart from the question of such contamination, it is said on good authority that the proportion of nitrates in chalk wells varies in different counties. The standard, therefore, of nitrates, as well as chlorides, has to be fixed by localities, and is partly determined by considerations of geology. The significance of the fluctuations or variations in the quantity present is that the nitrogen in sewage has become fully

Inorganic
Matter.

oxidised, no doubt by the action of living organisms present in the soil and present also in sewage itself. It cannot, however, safely be inferred that oxidation implies that the organisms which have a disease-producing power have become destroyed or rendered innocuous in the process.

Nitrites may result from the oxidation of ammonia or from the reduction of nitrates. In either case their presence shows that the matter, usually of animal origin, whether derived from manure or sewage, is undergoing change.

Ammonia.—This is contained in the air in minute quantities, and slightly in excess of the normal proportion in the neighbourhood of large cities. Rain water, therefore, contains it in minute quantities. It may also be found in the water of deep wells, as, for example, in the water of the Greensand and artesian wells in London. In these cases it is supposed to be generated by a chemical action on the nitrates of the water by the metal of the bore tube.

Phosphates, when present, are widely distributed, and traces may be dissolved by water, especially those rich in carbonic acid. Traces of this mineral substance may also, in certain circumstances, help the chemist in determining the probability of sewage pollution.

ORGANIC MATTER.

Organic
Matter.

The determination of the organic matter is even more important than that of the inorganic matter.

Albumenoid Ammonia, as it is called, is the result of boiling water containing organic matter, whether animal or vegetable, with a strong alkaline solution of permanganate of potash. The ammonia which is thus yielded by potable waters is called albumenoid or organic ammonia. It is interesting and important to note that soon after the Public Health Act of 1872, when sanitary matters began to receive general attention, it was thought that a standard of albumenoid ammonia might be made an index to the safety of a potable water, just as lately "the number of bacteria

permissible" has been suggested as a standard of potable water. ^{Organic Matter.} In a well-known work written about that time, .01 per 100,000, or as we would prefer to express it now, .1 part per million of albumenoid ammonia, was the limit of safety. Twenty years later we have a limit of 100 microbes (bacteria) present in 15 drops of water set up as a similar standard of safety !

The impossibility of establishing such a standard in chemical matters has been recognised long ago, and in like manner the impossibility of fixing a standard by the biological method will also have to be explained.

The former method is unsound for these reasons. In the first place the chemist cannot distinguish albumenoid matter which is of vegetable origin from that which is of animal origin. Water from the uplands may be quite pure and fit for drinking purposes, and yet be comparatively rich in albumenoid ammonia. Neither can the chemist discover the difference between the animal matter which is of a nocuous character and that which is innocent of any disease-producing quality. Consequently some particular traces of organic matter known to possess disease producing-qualities—the poison of Typhoid or Cholera to wit—may be present in quantities quite sufficient to produce disease, and at the same time the quantity of albumenoid ammonia yielded would be far below the limit suggested. By parity of reasoning the method which has been suggested of determining the potability of waters by the number of bacteria present may be described as very illogical. This part of the subject will be discussed further on. Meanwhile, it might be mentioned that in addition to the albumenoid ammonia test we have the test of organic matter afforded by the amount of oxygen absorbed. This process, like the former, does no more than tell us of the amount of organic matter, which is in an unstable or changing condition. It does not distinguish between animal and vegetable organic matter, while of course it cannot absolutely determine, any

more than the previous test, the presence or absence of a disease-producing quality in water.

To repeat, therefore, the oft-quoted words of the Medical Officers of the Local Government Board: "the chemist can, in brief, tell us of impurity and hazard, but not of purity and safety. For information about these we must go, with the aid of what the chemist has been able to teach us, in search of the conditions surrounding water sources and affecting water services" (*vide* Report of the Medical Officer of the Local Government Board, 1881, repeated by the present Medical Officer, Dr. Thorne, p. 24 of his Supplementary Report on Oyster Culture in relation to Disease).

Where the water is certainly known to be contaminated by sewage, or known to be liable to sewage pollution, chemical analysis at the source is, in a certain sense, often superfluous. Chemical analysis has its use—a very important use; it is only when it is made sole arbiter between safety and risk that it is abused, and sometimes leads to errors fraught with disastrous consequences. Whether biological examination of water is likely to take a more important place yet remains to be seen.

BACTERIOLOGICAL RESEARCH—ITS SCOPE AND INTERPRETATION.

At the time already referred to in these Reports—viz. (about 1872) the discovery of minute living organisms (microzymes, as they are called by Sir John Simon), and the share they had in the production of diseases, had only just been made by Pasteur. It was years before the discovery could be said to have had any practical application, and it is only within the last few years that the application of bacteriology to water examination has been brought into use. This department of science is still young. Common bases of observation have yet to be established. The new science has been brought into requisition for practical purposes somewhat too soon. Conclusions have been arrived at that are not warranted by the

present state of knowledge. It is from this that has arisen much of the extraordinary discord of observations revealed to the public in connection with the reports of the London County Council and their critics. Bacteriological Research and Water Supplies.

Formerly, the microscope was used for the discovery of such indications of organic pollution, animal or vegetable, as were to be shown in the sediment of waters revealing the presence of hairs, fibres, or animalcules, &c. These particles, small as they are, are gigantic in comparison with the microbes of which so much is heard at the present day. Science has at the present time reached a stage in which the following diseases—Diphtheria, Typhoid, Cholera, Tetanus (Lockjaw), Anthrax, Tubercle (Consumption), and various kinds of Septicæmia—are definitely known to be related to actual living organisms which may be separated and cultivated, and by their methods of cultivation may be used for the purposes of distinguishing the nature of, and even treating the diseases. This is an enormous advance upon the knowledge of even a few years ago, but we are very far as yet from having reached the stage which the public might be led to assume had been attained.

That there are disease-producing organisms is a great truth. It is an equally great truth that organisms of all kinds, some of them bearing close resemblance to disease organisms, are almost ubiquitous. In fact one of them, technically called the *bacillus coli communis*, is found to be present in innumerable articles of food. It is admitted now by the eminent bacteriologist, who formerly regarded the presence of this organism as a sign of absolute danger, that it is not so. For not only is this organism present under such conditions as would seem to imply that it is harmless itself, but it is also not even an indication of harm. Again, some of the bacteriologists' condemnation of waters has left out of account a consideration of prime importance arising out of discoveries now abundantly proved and fully accepted by the authorities in this branch of science. It is

that in this great world of microbes there are myriads living and active which are not only innocuous to human beings, but also actually beneficial in their action as destroyers of filth and infection.

The estimate of the mere number of microbes in 15 drops of water as an arbiter of its purity is surely more fallacious than was the estimate of the living organic matter by chemical methods. In the discussion at the Institute of Civil Engineers it was stated by Professor Percy Frankland that the whole of this misunderstanding about the mere number of bacteria has been largely owing to so great an authority as Koch of Berlin having come to a conclusion many years ago, when the data were insufficient, that good water should not contain more than about 100 bacteria per 15 drops. It is, as we know now, not the number, but the quality of the microbes that is in point. There are colonies of friends as well as foes.

Dr. Frankland further remarked, in the statement from which I am quoting, that a deep well water of unimpeachable quality becomes in a few days peopled by hundreds of thousands of bacteria per 15 drops, and yet nobody would venture to assert that the water was any the worse for their presence. This indicates the second great source of fallacy in the estimation of the quality of water by the counting method. A water pure at its source, derived, for example, from (1) the Greensand of Leith Hill, (2) one of our best and purest wells in the chalk, or (3) from river water which passes through the filtration processes of the West Surrey Company under the most favourable conditions, might contain a comparatively small number of microbes at the source or centre of distribution, and yet a very large number of innocuous microbes at the point of delivery or at the time of its consumption.

It has already been said that up to the present time the only diseases definitely known to be conveyed by drinking speci-

fically infected water, and the micro-organisms of which have been discovered in such waters, are Cholera and Typhoid Fever. The utmost, therefore, that can be expected of the bacteriologist is that he should discover and identify the Cholera or Typhoid bacillus, should either of these organisms be present in a sample of water submitted to him for examination. It is recognised, however, that the multitude of other bacilli present renders this a difficult and even impossible task. It is like looking for a needle in a stack of hay. Whilst, therefore, the absolute identification of the specific cause of Cholera or Typhoid Fever establishes its presence, the failure to isolate it is not proof of its absence. I have been told by those who had to do with examinations of water in notorious outbreaks of waterborne Typhoid, that samples of the water taken at the time of the rising epidemic, have been examined with negative results, so far as the production of colonies of the Typhoid bacillus was concerned. This was very likely due to the fact that just as clouds are seen floating in the comparatively clear atmosphere, so vast volumes of water may contain their clouds of bacteria. The contagion of Typhoid consists in an infectious material comprising the finest particles of insoluble matter. We are dealing, therefore, with something which is essentially different from that which is soluble, such, for example, as common salt. Adding to a million gallons of water some few ounces of common salt, there would result what is known as a "chemical solution," very dilute it is true, but still a solution in the scientific sense. But if there be added to a similar quantity of water a few ounces of this particulate matter, it remains present in the water undissolved and very unequally distributed. Here, then, we have a "mechanical mixture," more or less unequally distributed, in contradistinction to a chemical solution. Microscopic bodies may thus be widely separated; though they may at one time tend to multiply and crowd together in microscopic shoals, they may at another time tend to lose all vitality. Thus it happens that occasionally samples of water taken from this "mechanical mixture" arising from the mingling

Bacteriologi-
 cal Research
 and Water
 Supplies.

of a few ounces of solid matter with a huge volume of water, whether selected or not, must often fail to exhibit the microscopic particles.

It is owing in some measure, therefore, to misunderstanding as to the powers of the science of Bacteriology, that some have been disposed rather to minimise the importance of such examinations. This is unfortunate, as many of us believe that, when further developed, it will prove to be a very valuable addition to our means of research. The pity is that it has been over-estimated at the outset.

Here let me quote the Royal Commission on the Metropolitan Water Supply for 1894. They point out that the Typhoid bacillus, so far as is known, does not retain its vitality long apart from the human body, and that in all ordinary waters there exists organisms which undoubtedly "influence the diminishing vitality of the Typhoid bacillus; that exposure to direct sunlight destroys these bacteria; they have a tendency to die off more or less rapidly in all slowly-moving waters, and to be carried down with other matters held in suspension"; and such being the case, they fall back upon the evidence of experience. They "state without hesitation that, as regards the diseases in question, which are the only ones known to be disseminated by water, there is no evidence that the water supply to the consumers in London by the Companies is not perfectly wholesome."

Neither Chemistry nor Bacteriology, therefore, is to be wholly and solely depended upon for deciding these questions.

THE REAL VALUE OF ANALYSIS AND RESEARCH.

In thus explaining, to the best of my ability, the position which laboratory analyses hold in relation to public health inquiries, I would not for a moment wish to have it supposed that I undervalue them in the slightest degree. My meaning is rather that they are

supplementary or auxiliary to inquiry of a medical nature which has generally been spoken of as epidemiology, and which consists mainly in observation of facts by the light of medical knowledge respecting the natural history of the infectious diseases, and the comparison from time to time of those observations. Such observations by medical men in the various departments of the public service are constantly being recorded.

The value of analyses is a growing one. It must obviously be so from the fact that every year is adding to our sum of knowledge respecting bacteriology. The development of this science has been extraordinary, and it would, indeed, be strange if we did not in future acquire from it even greater assistance. The chief desideratum is that its development should be properly encouraged. I am anxious to make myself clear upon this point, because I have noticed with some disappointment, in the course of my inquiries into several water supplies in Surrey, that the Companies have not recognised the importance of having analyses made as much as might have been expected. I think that the example of the London Companies is one that should be followed, and I may express the hope that before long all the Companies supplying water in Surrey will arrange to have periodical chemical and bacteriological analyses. It will be seen from what I have already said that the chief use of Bacteriology is the detection of organisms in water and their varying relations to each other. This work is sure to be one of the most necessary aids to those who are endeavouring to maintain safety for water supplies. These methods of observation and research along with the chemical analyses, ought, I think, to be resorted to by every company from time to time, so as to ascertain all that can be learnt respecting the condition of the water that they are supplying, and its possible relation to the public health.

MOVEMENTS OF UNDERGROUND WATER.

Here I would refer to the necessity for promoting official inquiry, accompanied by accurate and systematic records by skilled

The need
for Research
Work.

Geological
Researches.

The need for
Observation.

trained observers into the movements, vertical and lateral, of underground water. Such inquiry would take account of the effects of pumping in various degrees upon the area of water-bearing strata affected (the cone of depression), especially as regards the passage of underground water in relation to time. I am convinced that those who have followed this subject will agree that there is no department of research more promising of profitable results to the public health. There are gentlemen residing in the County and in Croydon who have given valuable time and thought to this subject for several years. It is highly desirable that the work they have initiated should be continued and extended on a systematic basis. I believe that it would materially help to elucidate the subject if the Council could see its way to promoting research work in this direction.

THE EVIDENCE OF EXPERIENCE.

The Evidence
of Experience.

The value of analysis has been discussed first, although properly speaking the evidence of experience in connection with the natural history of epidemic disease should have preceded it. It is indeed on this kind of evidence that the main progress of preventive medicine in this and other countries has, until a comparatively recent period, been based. It is on such evidence that measures of prevention must necessarily continue to proceed.

It is unnecessary to repeat what has already been said with regard to the studies of the prevalence of Typhoid Fever during the last quarter of a century, but it will be proper to mention here a recently published report or memorandum by Mr. Shirley Murphy, the Medical Officer of the London County Council.

Although we have the authority of the Metropolitan Royal Commission for the statement that, speaking generally, the evidence of experience is entirely against the idea that the Typhoid Fever in London is to any appreciable extent caused by the conditions of the water supply at the centres of distribution, we have also a

carefully prepared memorandum or report on what, speaking The Evidence relatively, must be described as a "general scattering of Typhoid of Experience. Fever" throughout the metropolis during the first three weeks of December, 1894, which, it is argued, must have arisen from the water supply.

It appeared that, about a fortnight previous to the increase, both the Thames and the Lee had been in flood, and that the water furnished by the companies deriving their supplies from these rivers had been sufficiently contaminated to require an unusual amount of oxygen for the oxidation of its organic matter. The cases of fever were not sufficiently numerous to constitute any grave danger to the public health, but they were in marked excess of the normal average of the time, and, so far, the observed conditions show that in all probability the mode and rate of filtration, which are usually sufficient for all practical purposes, may cease to be sufficient when from any cause an unusual amount of impurity obtains access to the sources of supply.

The same sequence of events has been recorded and commented upon by Professor Corfield, Medical Officer of Health for St. George, Hanover Square.

Though great weight must necessarily be attached to the statement of these two recognized authorities, it may be noted that the increase of Typhoid in 1894 has not, as far as I know, been commented upon by any of the other 40 or more Medical Officers of Health in London. This may or may not have been due to its admittedly small proportions, and its therefore comparative imperceptibility.

I myself, with most careful observation, have found no sufficient ground for believing that the river water supplies have been concerned in the production of Typhoid outbreaks any time during the last six years in the County of Surrey.

In the foregoing pages I have given reasons for believing that fluctuations of Typhoid prevalence are markedly affected by other

influences than those affecting drinking water-supplies. Constant attention to filtration methods of river water-supplies, as well as improvement of storage of river water, obviously requires to be insisted on. But I note with interest that in the Report of the Administrative County of London for 1895, just issued, the Medical Officer speaks of the "need of longer experience of Notification," in order to show the precise meaning of increases and decreases of Typhoid at certain periods of the year.

GENERAL PROVISIONAL CONCLUSIONS.

Conclusions.

The Report which I now have the honour to make represents the best of my information on the subject of water supply at the present time. I have endeavoured to state the facts within my knowledge as clearly and candidly as possible, and to arrange them conveniently for the use and information of the Council. I beg herewith to record both these conclusions to which they would seem to point:—

1. That as regards the supplies of the River Water Companies, in addition to the progressive work of river conservancy and purification, the attention of authorities needs to be continuously directed to the condition of the water at the varying points of intake and to the methods of storage and filtration adopted by the Companies.

That, provided proper attention to these essential matters be secured, our River Water Supplies may be considered satisfactory in quality.

2. As regards quantity of supply, I do not think there is reason for uneasiness in the county generally. But there is one rapidly-growing district which may not unlikely need more water than can be found in the

locality. The policy of the Council is to conserve county water sources for county use. The exercise of its powerful influence by the Chairman and representatives has already secured substantial benefits for the population in Rural Surrey. There has just been noted a partial deficiency. Let it also be noted here that there are, to the best of my information, reserves of supply. I refer not only to the excess yielded by the more copious of the subterranean sources of the cretaceous formation, but also to the surplus river water on which the County Companies in the Thames Valley have a right to draw, and, further, to the bountiful springs of pure, soft water in the high regions of the Greensand Hills. In indicating the possible utilization of these reserves in the future, I am probably suggesting matter worthy of careful consideration.

3. The quality of water supplies needs continuous observation. It is surely to the interest of the companies concerned to maintain this. Periodical analyses and laboratory researches are arrangements for the companies themselves to provide. But in addition it would be very advantageous if the Council should see fit to promote inquiry respecting the movements of underground water in water-bearing strata, and as to the way in which their quality may possibly become affected.
4. As regards other practical measures of precaution, it seems to me that while one would in deference to the views of others, give preference to cemetery sites which were unobjectionable, I do not see my way to suggesting any immediate step from the County point of view.

Conclusions.

On the other hand as regards cesspools in *all* porous soils, including the upper and lower cretaceous formation, I think the practical course would be to recommend District Councils to proceed against soak-away cesspools as nuisances, under the clauses of the Public Health Act, taking, of course, those first which were most likely to become sources of danger by contaminating the underground water.

I am,

My Lords and Gentlemen,

Your obedient Servant,

EDWARD SEATON.

TO THE COUNCIL
OF THE
ADMINISTRATIVE COUNTY OF SURREY.

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